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FIRESTOPPING

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DEPARTMENTS OF THE ARMY AND THE NAVY

15 January 1986

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DEPARTMENTS OF THE ARMY
AND THE NAVY
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FIRESTOPPING

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CHAPTER 1

GENERAL

1-1. Purpose.

This manual presents methods and details for firestopping fire-rated assemblies (walls, floors, ceilings, etc.) when those assemblies are either partially or fully penetrated by pipes, ducts, conduits, or other such building elements. This manual applies to all elements responsible for design of Army and Navy construction.

1-2. Scope.

Firestopping by the placement of appropriately tested and fire-rated materials in and/or around penetration of fire-rated assemblies will maintain the fire resistance rating. If the rating is not maintained, such a loss would allow for the spread of flame, smoke, and gases from one fire area or smoke compartment of the building to another. Firestopping includes but is not limited to the following:

— The filling of voids created when fire-rated assemblies are penetrated, either partially or totally, by various building components and elements (e.g., pipes, ducts, conduits).

— The blocking-off of internal spaces within fire-rated assemblies to limit the spread of fire within the assembly.

— The special connection required at the interface of a fire-rated assembly and other assemblies of the building (e.g., the floor/ceiling connections to a curtain wall assembly).

This document describes the various means and methods of firestopping fire-rated assemblies when the fire resistance integrity of such assemblies are violated by various penetrations. The document is applicable to new construction, renovations, and rehabilitation of existing buildings.

1-3. Definitions.

a. Fire Resistance Rating—The time in hours or fractions thereof that materials or assemblies of materials will resist fire exposure as determined by ASTM E 119, NFPA 251, and UL 263.

b. Fire Resistance—That property of materials or their assemblies which prevents or resists in a specified time the passage of excessive heat, hot gases, or flames under conditions of use.

c. Firestopping—Building materials installed to prevent movement of flame, smoke, gases and heat through openings and/or passages within the assembly and at penetrations. Firestopping in fire-rated assemblies will maintain the integrity of the fire resistance rating.

d. Penetrations—Openings made in fire-rated assemblies that negate their fire resistance rating. Penetrations are made to provide for the passage or placement of building elements which include, but are not necessarily limited to, conduits, piping, fixtures, boxes, ducts, and the like. Penetrations fall into two categories as follows:

— Partial penetrations are those which pierce or interrupt the outside surface on only one side of a fire-rated assembly and some other elements of the assembly.

— Through penetrations are those which pierce or interrupt the outside surfaces on both sides of a fire-rated assembly, as well as intervening elements of the assembly.

1-4. Fire-rated assemblies.

a. Building elements, including columns, beams, girders, floors, floor/ceiling assemblies, roofs, roof/ceiling assemblies, wall assemblies, walls, partitions and partition assemblies, are tested in accordance with ASTM E 119 fire test in order to assign a fire resistance rating stated in hours and half hours. In this test, a building element or assembly of a prescribed size is mounted in the furnace or furnace opening and a fire environment is created inside the furnace in accordance with the time-temperature curve shown by figure 1-1.

b. Fire-rated building elements and/or assemblies are tested in the configuration submitted by the sponsor of the test. In some cases, the fire-rated assemblies have penetrations such as lighting fixtures, grilles, ducts, boxes, and the like; other assemblies are tested without such penetrations. Where the assembly has penetrations and has successfully passed the test for a specific fire resistance rating, the actual construction in the field must either duplicate the tested assembly or have fewer penetrations. In either case the penetration must be in the same locations as tested.

c. Fire-rated assemblies may be tested without load if the assemblies are non-load-bearing, or under load if the assemblies are being rated as floors, roofs, or bearing walls. The failure criteria for the fire test in most cases are:

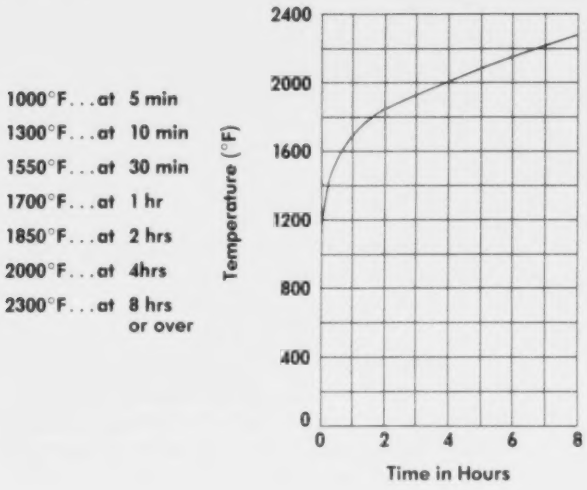


Figure 1-1. Time-temperature curve.

— Ignition of cotton waste on the unexposed face of the assembly being tested.

— Transmission of enough heat through the assembly to raise the average temperature on the unexposed face of the assembly more than 250 degrees F above the initial temperature nor to raise the temperature at a single measurement point more than 325 degress F above the initial temperature.

— The failure of the assembly to sustain the required loading for the duration of the test (in the case of load-bearing assemblies).

d. Fire resistance rated assemblies are those which have been tested and rated by approved independent testing laboratorie. These are listed in the following documents:

— *Gypsum Association Fire Resistance Design Manual.*

— *U.L. Fire Resistance Directory.*

— *AIA Fire Resistance Ratings of Beam, Girder and Truss Protection Ceiling Constructions, Column Protection, Floor and Ceiling Constructions, Roof Constructions, Walls and Partitions*

— *FM Approval Guide.*

— *SMACNA Fire Dampers and Heat Stop Guide for Air Handling Systems.*

e. This manual is concerned with the treatment of penetrations through rated assemblies that were tested without the penetrations in place This manual describes measures required to maintain the rating of the penetrated assembly and is not concerned with the design of fire-rated assemblies themselves.

1-5. Fire tests of through-penetration firestops.

a. In 1981, ASTM adopted as a standard, E 814. This test method is designed for those penetrations necessary for the distribution of services through a building such as cables, conduits, pipes, trays, and ducts. These types of penetrations compose a major portion of the types of penetrations this technical manual addresses. This test procedure is limited by definition to these penetrations that completely pierce a fire-rated assembly.

b. The ASTM E 814 test procedure incorporates the ASTM E 119 requirements of the Standard Time-Temperature curve. While the acceptance criteria (or failure criteria) are basically the same as for ASTM E 119, tests performed under ASTM E 814 result in the issuance of two ratings, an "F" rating and a "T" rating, as follows:

— The "F" rating is concerned with the penetration's resistance to the passage of flame (the cotton waste test of ASTM E 119).

— The "T" rating is concerned with the temperature rise on the unexposed face of the assembly or on the penetrating item on the side of the unexposed face of the assembly. This limiting temperature is 325 degrees F above the initial temperature. (This end point temperature is identical to the maximum hot thermocouple temperature permitted under ASTM E 119.)

c. Factory built or assembled products which have been tested and rated in accordance with ASTM E814 are listed in UL Building Materials Directory.

CHAPTER 2

PENETRATIONS

2-1. General.

a. This chapter identifies the types of penetrations of fire-rated assemblies found in buildings. The methods recommended for firestopping these penetrations in new and existing buildings are addressed in chapters 4, 5, 6, and 7. Wherever possible, penetrations of fire-rated assemblies should be avoided. Panel boxes, extinguisher cabinets, and other similar devices, where practical and functionally acceptable, should be surface supported.

b. Penetrations are either through or partial.

(1) Examples of through penetrations are:

— A heating/ventilating/air conditioning (HVAC) duct that passes completely through a wall or partition, or through a floor/ceiling assembly.

— Piping or conduit that passes completely through a floor/ceiling assembly, or through a wall or partition.

(2) There are two types of partial penetrations. One is those penetrations where the penetrating element extends to other locations within the fire-rated assembly or elsewhere in the building. Examples of partial penetrations of this type are:

— An electrical receptable box located in one face of the wall or partition with the wiring to the box running vertically within the wall or partition.

— A floor register located in the floor of a floor/ceiling assembly with the associated ductwork located within the plenum space of the floor/ceiling assembly.

The other type of partial penetrations is that where the penetrating element does not extend beyond the location of initial penetration. An example of this type is a fire extinguisher cabinet set in one face of a wall or partition.

c. When a through penetration violates the integrity of a fire-rated assembly, the critical concern is the passage of heat, flame, smoke, and gases through the fire-rated assembly.

d. When a partial penetration violates the integrity of a fire-rated assembly, the integrity of one side of the assembly is maintained; therefore there are two critical concerns:

— The effect of the partial penetration on the supporting elements of the assembly, especially in load-bearing assemblies.

— The passage of heat, flame, smoke, and gases through the assembly to other locations within the building.

2-2. Typical penetrations associated with the construction disciplines.

a. Plumbing

(1) Water piping (including sprinkler piping) metallic or non-metallic

(2) Drain/waste/vent (DWV) pipes—metallic or non-metallic

(3) Access panels

b. Heating/ventilation/air conditioning (HVAC)

(1) Ducts—metallic or non-metallic

(2) Flues

(3) Registers/grilles—metallic or non-metallic

(4) Equipment

(5) Controls

(6) Access panels

c. Electrical

(1) Conduit—metallic or non-metallic

(2) Light fixtures

(3) Panel boxes

(4) Acess panels

(5) Outlets/junction boxes/switches—metallic or non-metallic

(6) Cable trays

d. Miscellaneous recessed boxes

(1) Hose cabinets

(2) Fire extinguisher cabinets

(3) Medicine cabinets

(4) Mail chutes

2-3. Electrical appurtenances.

Certain manufactured electrical appurtenances, including outlet boxes, junction boxes, breaker panels, fixtures, and the like have been tested under fire exposure conditions approved and/or listed for use in fire-rated assemblies. These appurtenances have specific design features which may preclude the need for additional firestopping other than normal patching where installed as a penetration of an element of a fire-rated assembly. Installation criteria for these appurtenances are identified in the manufacturers' printed installation instructions. All other such appurtenances will be

firestopped as described and indicated elsewhere in this manual.

2-4. Through penetrations by insulated pipes or ducts.

a. Insulation materials penetrating any fire-rated assembly shall maintain the integrity of the fire-resistance rating. Generally, insulation materials which will not disintegrate or melt away exposed to temperatures up to 1800 degrees F are to be used. Where pipes or ducts insulated with materials other than the above penetrate any fire-rated assembly, the insulation will be removed. The portion to be removed is where the pipe or duct that lies within the fire-rated assembly and a distance of 6 inches from each exterior surface of the assembly. If insulation is required at the penetration, the replacement insulation will be a material which will maintain the integrity of the fire-resistance rating by fire-tests or which will not disintegrate or melt under the conditions specified above (see fig 2-1).

b. Where insulated pipes or ducts with insulation which penetrate any fire-rated assembly, or where the insulation has been removed from such a pipe or duct in accordance with paragraph *a* above, the penetration should be firestopped as specified in chapters 4 through 7.

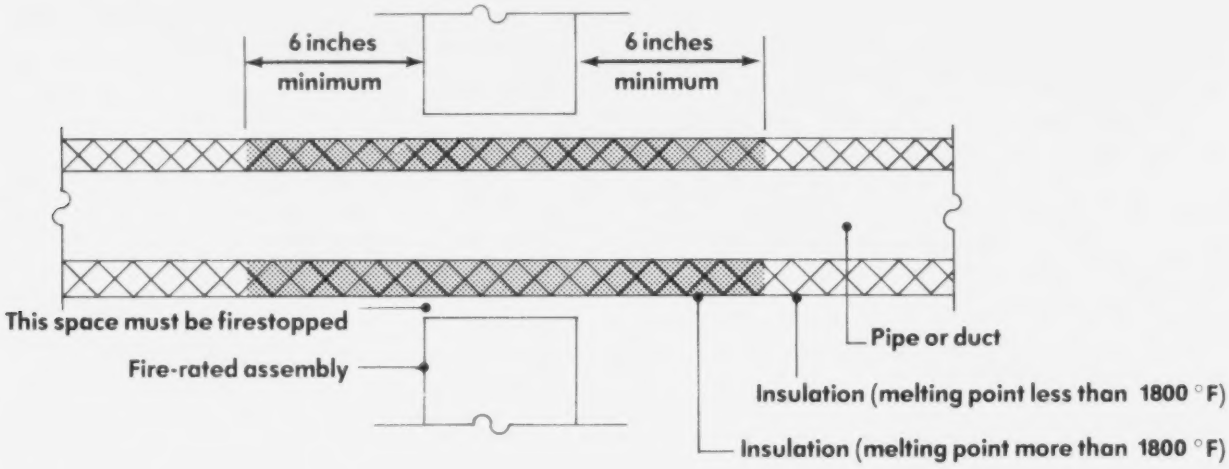


Figure 2-1. Through penetrations by insulated pipes or ducts.

CHAPTER 3

FIRESTOPPING MATERIALS

3-1. General.

a. This chapter describes the materials to be used in firestopping penetrations. Chapters 4 through 7 address the application and use of these materials with specific fire-rated assemblies.

b. The firestopping of any particular assembly may be accomplished by utilizing a single material or by combinations of more than one material. In some cases, the nature of the penetration may require that allowances be made in the firestopping construction to permit movement of the penetrating elements. Such movement may be caused by expansion, contraction, impact (water hammer) and the like. Firestopping, while allowing for movement, must still maintain the integrity of the fire-rated assemblies.

c. Table 3-1 shows which firestopping materials are most appropriate for use between the penetrating element and specific floor or wall assembly materials or sleeves.

d. The use of some firestopping materials may be limited by other than fire resistance criteria. All such materials should be used in accordance with criteria stipulated in tests utilizing such materials.

Table 3-1. Firestopping material uses.

		FIRESTOPPING MATERIALS					
		MINERAL WOOL INSUL.	GROUT	PLASTER PATCH/ SPACKLE	PLASTIC	FOAM	ESCUTCHEON PLATES
FLOOR OR WALL ASSEMBLY MATERIALS	CONCRETE	2	1	-	3	3	-
	BRICK	2	1	-	3	3	-
	CONCRETE MASONRY UNITS	2	1	-	3	3	-
	GYPSUM BOARD	2	-	1	3*	3	3
	PLASTER	2	-	-	3*	3	3
	ACOUSTICAL MATERIAL	2	-	-	3*	3	-
SLEEVE		2	1	-	3*	3	3

1 Will not accommodate movement of the penetrating element

2 Will accommodate movement of the penetrating element

3 Use should be in accordance with criteria resulting from specific tests

* No test data or construction details available

3-2. Mineral wool insulation.

a. Mineral wool materials used in firestopping are inorganic materials in the form of batts, or boards weighing not less than three pounds per cubic foot, conforming to Federal Specification HH-I-558 and which will not disintegrate or melt when exposed to a temperature of 1800 degrees F.

b. Certain assemblies which include mineral wool batts and boards not meeting the temperature criteria specified above may be tested and rated for specific fire resistance ratings. These mineral wool batts or boards generally consist of glass fibers bonded together with a bonding agent. Mineral wool materials in those assemblies are located such that they are not directly exposed to the furnace temperatures associated with the ASTM E 119. Since they have been tested as part of an assembly, their use is permitted in the assembly but not as firestopping.

c. The use of mineral wool in firestopping penetrations may be in several forms:

— As the basic firestop materials where it is packed or wedged tightly to fill the void between the penetrating element and the fire-rated construction.

— As a firestop material packed tightly between the penetrating element and a sleeve.

— As a form or dam for use in combination with a grout, plaster patch/spackle, or plastic firestopping material.

— As additional fire resistant material in the form of batts or boards placed directly behind partial penetrations to provide the required fire-rating of the assembly.

3-3. Grout.

a. Grout is used to seal or fill the space between unit masonry (brick and concrete masonry units) construction and the penetration or the sleeve where the penetration is contained in a sleeve. Where penetrations are introduced in new unit masonry construction, the grout should be the same as the mortar used to lay up the unit masonry.

b. Grout sets up in a hard, non-elastic end product, and it should not be used where penetrations are subject to thermal expansion and contraction, and deflection or movement resulting from impact.

3-4. Plaster patch/spackle.

Patching plaster, spackling material, and joint compound are used in firestopping in plaster and gypsum board assemblies. Where used in new construction they should be of the same mixture as those used in the installation of new plaster construction and/or gypsum board construction. Where used as firestopping around penetrations in existing construction, they should be of the prepackaged type appropriate for use with the particular construction involved. Taping in addition to spackling may be required by the nature of the opening around the penetration in gypsum board construction. These materials can only be used when the space to be filled is 1/2-inch or less.

3-5. Plastic.

a. The plastic materials used in sealing penetrations of fire-rated assemblies are derived from a family of rubber based intumescent materials. Because of their intumescent properties, these materials expand volumetrically when exposed to temperatures of 250 degrees F and above, creating a high strength, insulating char which fills annular spaces around penetrations, and is capable of withstanding thermal shocks, resisting the pressure generated by hose stream applications, and preventing the passage of smoke from one side of an assembly to the other. All plastic materials used for firestopping penetrations should be of an approved type as evidenced by passing ASTM E 814. Such materials are produced in the following forms:

— calking

— putty

— sheets

— preformed blocks provided with holes for receiving cables, pipes, and conduits of various diameters.

b. Plastic calking or putty is generally used in concrete floors and walls, and in unit masonry walls, and can receive grout, plaster patch/spackle, or paint to match the finish of adjacent areas. The maximum annular space between penetrations and the edge of the opening in the floor or wall should not exceed two inches except if tested and approved otherwise. The minimum depth of the calking or putty should generally be one inch, although other depths may be mandated by specific tests. A dam or form made up of mineral wool batts or blankets should be provided to prevent seepage of fill material while the calking or putty is in its viscous state.

c. Plastic sheeting is installed by forming around pipes, conduit, ducts, and the like for the required depth of the penetration based on specific tests for particular installation in each element of the assembly. Where exposed in finished areas, the outermost space can be filled with plastic putty to provide a smooth exposed surface.

d. Plastic firestopping material of the preformed type (blocks with holes provided to receive the pipes, conduits, and/or electrical cables) should have preformed holes of the proper size to fit the penetrations.

The entire assembly of preformed plastic material and penetrating element is then held in place by a metal frame equipped with a compression fitting that holds the material in place. Frames are of various sizes and nomenclature readily adapted to various types of construction.

3-6. Foam.

Silicone foams that have been tested in accordance with ASTM E 814 may also be used in firestopping penetrations. There may be limitations on the use of silicone foams with regard to area of penetration and depth of penetration; the use of silicone foams should be in accordance with the conditions under which they were tested.

3-7. Escutcheon plates.

Certain gypsum board assemblies with pipe penetrations have been successfully tested with firestops consisting of escutcheon plates. Such escutcheon plates may be used as firestopping if installed as tested and rated.

3-8. Gypsum board.

a. Gypsum board may be used as a firestopping material in assemblies of gypsum board or other materials. In gypsum board assemblies, gypsum board may be used to frame an opening for rectangular penetrations of all sizes and larger round ducts. For partial penetrations in walls of any material, gypsum board may be placed directly behind the partial penetration to maintain the required fire rating of the wall. In ceilings of gypsum board and plaster material which are an integral part of a fire-rated floor/ceiling assembly, gypsum board and plaster may be placed above the ceiling to surround the partial penetration of such elements as recessed luminaires to maintain the required fire-rating.

b. When used in gypsum board assemblies, the firestopping material should be of the same type as used in the primary assembly. When used in other assemblies, fire resistance rated gypsum board should be used. Joints in gypsum board firestopping should be taped and spackled, except where the joint is backed by a framing member or another layer of gypsum board.

3-9. Acoustical materials.

Acoustical materials may be used as firestopping materials. In ceilings where the acoustical material is an integral part of a fire-rated floor/ceiling assembly and is partially penetrated by such elements as recessed luminaires, the acoustical material can be placed above the ceiling to surround the partial penetration and maintain the required fire-rating.

3-10. Proprietary sprayed-on materials.

Proprietary sprayed-on materials that have been tested and fire rated in accordance with ASTM E 119 may also be used as firestopping for partial penetrations.

3-11. Sleeves and framed prepared openings.

Openings in bearing walls and floors for penetrating elements such as pipes, conduits, cables, and smaller round ducts which should be sleeved, should utilize black steel or cast iron pipe. Similar openings for round penetrating elements in non-bearing walls may in addition, use sleeves of galvanized steel. Sleeves should be fitted into place at the time of construction. Openings for rectangular penetrating elements and larger round ducts should be framed prepared openings.

3-12. Weather protection of materials.

Some firestopping materials may degrade from the effects of wind, water, ultraviolet sunlight, ice, expansion, and contraction. When firestopping materials are used in exterior locations and when these materials are subject to degradation as noted above, one firestopping detail should include proper treatment with finishing materials or cover plates to protect the integrity of the firestopping.

CHAPTER 4

WALLS/PARTITIONS

4-1. Introduction.

This chapter addresses the types of fire-rated walls/partitions (hereinafter referred to as walls) which are most commonly used in present day construction. For each type, a guide is provided to indicate the wall material thicknesses and other details required to achieve the desired fire resistance ratings, followed by a discussion of the types of penetrations and their firestopping. Architectural details are also presented.

4-2. Fire resistance ratings.

a. Brick. The fire resistance rating of a brick wall is mainly a function of the thickness of the wall, or thicknesses in the case of a cavity wall. Brick walls consist of clay brick set in a mortar. Brick walls may be solid or include a cavity. The type of brick bond (e.g., stack bond, running bond, and the like), and the type of mortar used in a brick wall have very little effect on the fire resistance rating of the assembly. Table 4-1 identifies thicknesses of brick walls required to achieve specific fire resistance ratings. Cavity walls may, under certain conditions, form vertical shafts connecting two or more floors. Some of the firestopping details are shown in chapter 5.

b. Concrete masonry units (CMUs). The fire re-

Table 4-1. Fire resistance ratings of brick walls.

Type	Details of Construction	Members Framed in Wall — Minimum Thickness in Inches for Hourly Ratings of: Combustible 4	3	2	1	None or Noncombustible 4	3	2	1
Brick (clay, shale concrete, or sand-lime)	Solid walls plastered one side or unplastered	12	12	8	8	8	8	8	4
	Solid walls plastered each side with 1/2 in. 1:3 gypsum and sand or portland cement and sand plaster or 5/8 in. 1:2 1/2 portland cement and sand or lime and sand plaster	12	8	8	8	8	8	4	4
	Hollow "Cavity" type walls; 1/4 in. round metal ties spaced 2 ft. horizontally every 6th course	--	--	--	10	10	10	10	10

Type	Details of Construction	Rating
Cored	6 in. units 76% solid, unplastered; with noncombustible or no members framed into the wall	2 1/2 hrs.
	4 in. units 83% solid, unplastered; with noncombustible or no members framed into the wall	1 hr.
Hollow	8 in. units 71% solid, plaster on both sides with 5/8 in. 1:3 gypsum and sand plaster:	
	With noncombustible or no members framed into wall	4 hrs.
	With combustible framed in members fully embedded into wall	3 hrs.
	With unembedded combustible members framed into wall	2 hrs.
	8 in. units 71% solid, unplastered:	
	With noncombustible or no members framed into wall	3 hrs.
	With combustible framed in members fully embedded in mortar	2 hrs.
	With unembedded combustible members framed into wall	1 1/2 hrs.

sistance rating of a CMU wall is mainly a function of the type of aggregate, and the equivalent thickness of CMUs. Concrete masonry unit walls consist of solid or hollow blocks which may be made of various aggregates, and which are placed in a mortar. Equivalent thickness is the average thickness of the solid material in a wall which is determined by taking the total volume of the wall, subtracting the volume of the CMU core spaces, and dividing by the area of the face of the wall. Where walls are plastered or faced with brick, the thickness of the plaster or brick may be included in determining the equivalent thickness. The type of mortar used to bond the units together has little bearing on the fire resistance rating of the assembly. Table 4-2 identifies fire resistance ratings by types of aggregate, details of construction, and equivalent thickness. Additional fire-ratings have been established in accordance with ASTM E 119 or listed as complying with UL 618.

c. Concrete. The fire resistance rating of a concrete wall is mainly a function of the thickness of the wall and the type of aggregate used in the concrete. Concrete walls may be either cast-in-place or precast, and may be either reinforced or unreinforced. Table 4-3 identifies fire resistance ratings by thicknesses and types of aggregate.

d. Gypsum board. The fire resistance rating of gypsum board walls is provided by the overall assembly and is a function of the core formulation (regular or Type X), number of layers and thicknesses of the boards, and in the case of hollow assemblies, of the material and dimensions of the studs and the details of attachment of the boards. Walls made of gypsum may be either solid, consisting of two or more thicknesses of gypsum board and/or gypsum coreboard, or hollow, consisting of one or more thicknesses of gypsum board attached to wood, metal, or gypsum studs. Hollow walls may be filled with insulation materials of various kinds. Gypsum board walls may be load-bearing or non load-bearing. The fire resistance ratings of gypsum board walls are determined by individual fire tests performed in accordance with ASTM E 119. The ASTM E 119 test conditions for walls differ for load-bearing and non load-bearing conditions. In the former case, a possible mode of failure is structural failure of the studs, which leads to different firestopping details for through penetrations exceeding 16 square inches in area. Finally, hollow gypsum board walls may, under certain conditions, form vertical shafts connecting two or more floors.

e. Lath and plaster. The fire resistance rating of lath and plaster walls is provided by the overall assembly, and is a function of the type of plaster used, the thickness of the plaster, and in the case of hollow assemblies, of the material and dimensions of the studs, type of lath, and the details of attachment of the lath. Lath and plaster walls may be either solid, consisting of gypsum lath or metal lath attached to metal vertical and/or horizontal supporting channels and finished with plaster; or hollow, consisting of gypsum lath or metal lath attached to wood or metal studs with each face separately finished with plaster. Hollow walls

Table 4-2. Minimum equivalent thickness of concrete masonry units.

	Ratings[a]						
Aggregate Type	4 hrs.	3 hrs.	2 hrs.	1 1/2 hrs.	1 hr.	3/4 hr.	1/2 hr.
Expanded slag or pumice	4.7	4.0	3.2	2.7	2.1	1.9	1.5
Expanded clay, shale or slate	5.1	4.4	3.6	3.3	2.6	2.2	1.8
Limestone cinders or slag	5.9	5.0	4.0	3.4	2.7	2.3	1.9
Calcareous and siliceous gravel	6.2	5.3	4.2	3.6	2.8	2.4	2.0

Note a. Minimum wall thicknesses in inches for various aggregate types to achieve the indicated fire resistance ratings in hours. Where combustible members are framed into the wall, the wall must be of such thickness or be so constructed that the thickness of solid material between the end of each member and the opposite face of the wall, or between members set in from opposite sides, will be not less that 93 percent of the thickness shown above.

Table 4-3. Minimum equivalent thickness of concrete walls.

Concrete Type	Ratings[a]				
	4 hr	3 hr	2 hr	1 1/2 hr	1 hr
Siliceous	7.0	6.2	5.0	4.3	3.5
Carbonate	6.6	5.7	4.6	4.0	3.2
Sand-Lightweight	5.4	4.6	3.8	3.3	2.7
Lightweight	5.1	4.4	3.6	3.1	2.5

Note a. Minimum wall thicknesses in inches for various concrete types to achieve the indicated fire resistance ratings in hours. Applies to cast-in-place or precast concrete walls both load bearing and non-load bearing.

may be filled with insulation materials of various kinds. The plaster may be of various compositions of gypsum mixed with sand, vermiculite, perlite, and the like. Lath and plaster walls may be load-bearing or non load-bearing. Like gypsum board, the fire resistance ratings of lath and plaster walls are determined by individual fire tests performed in accordance with ASTM E 119, and are required for the acceptance of each particular assembly as a rated fire separation wall. Load-bearing hollow lath and plaster walls are subject to the same ASTM E 119 acceptance criteria and special fire-stopping requirements discussed for load-bearing gypsum board. Finally, hollow lath and plaster walls may, under certain conditions, form vertical shafts connecting two or more floors.

f. Combination walls. The fire resistance ratings of combination walls are determined by fire tests performed in accordance with ASTM E 119. Combination walls may consist of two or more of the basic types discussed in the preceding sections, or a basic type with a veneer finish or cladding attached to one or both faces. Some examples of combination walls are:

— CMU with brick facing.

— Brick veneer on gypsum board over stud wall.

— Metal or wood siding on gypsum board over stud wall.

4-3. Firestopping of brick, CMU, and concrete walls.

a. Pipes and conduits.

(1) Penetrations for pipes and rigid electrical conduit 4-inches or less in diameter which are not subject to movement should be grouted tight to the pipe or conduit as deep as possible but no less than 2-inches from each face of the wall and no less than the thickness of the exterior face shell wall of hollow CMU (see fig 4-1*a*).

(2) Larger pipes and pipes subject to movement will utilize sleeves for penetrating solid and cavity walls. Other pipes may also utilize sleeves if the penetration location is known when the wall is constructed. Such penetrations, when not utilizing a sleeve, should be firestopped by one of the following methods:

— Packing of mineral wool insulation for the full thickness of the wall (see fig 4-1*b*).

— Plastic materials or foam, installed in accordance with manufacturers' instructions (see fig 4-1*c*).

Sleeves, when used, should be grouted in place as recommended for pipes in (1) above, and mineral wool insulation should be provided between the pipe and sleeve for the full thickness of the wall (see fig 4-1*d*).

(3) Penetrations for pipes and rigid electrical conduit in concrete walls are generally done through sleeves placed at the time of casting. Mineral wool insulation should be provided between the pipe and sleeve for the full thickness of the wall (see fig 4-1*d*). Penetrations made by drilling or chiselling the concrete should be firestopped as recommended in (1) and (2) above (see figs 4-1*a*, 4-1*b*, and 4-1*c*).

b. Ducts.

(1) *Through penetrations.* Through penetrations for sheet metal ducts may or may not utilize sleeves and will be fire-stopped as required for larger pipes and pipes subject to movement with the addition of metallic flanges fastened to the duct and covering the penetration (see fig 4-2). Local job conditions, the size of the void between duct and penetration, and whether the penetration is an opening framed and prepared during the construction of the wall or is drilled or chiselled will determine which method is used. Ducts penetrating through walls required to be 2-hour rated

or more should be provided with sleeves and fire dampers or fire doors in accordance with TM 5-810-1. Such fire dampers or fire doors will be installed according to manufacturer's instructions. The sleeves should be fire-stopped with mineral wool insulation in the form of batts or loose fibers from each face of the wall to a depth of one inch, or up to the fire damper, whichever is greater (see fig 4-2). The mineral wool should provide a continuous seal to the entire space around the sleeve, but should not be packed tight through the full thickness of the wall, so as to allow the fire dampers or fire doors to expand.

(2) *Partial penetrations.* Duct penetrations of one face of a wall for the purpose of vertical or horizontal distribution within the cavity of a cavity wall, within the cell space of a single wythe of a CMU wall, or within the overall wall thickness should be provided with one of the following directly behind the penetration and at the duct:

- In a brick or concrete wall, sufficient thickness of material, as defined in Table 4-1 or Table 4-3, to provide the required fire-rating of the wall (see fig 4-3*a*).
- In a CMU wall, sufficient equivalent thickness, as defined in Table 4-2, to provide the required fire-rating of the wall (see fig 4-3*b*).
- In a CMU or concrete wall, material made of different aggregate providing higher fire resistance to maintain the required rating.
- The addition of fire resistant material of lesser but adequate thickness, such as gypsum board, mineral wool batts, or fibrous material to achieve the required rating (see fig 4-3*a*).

(3) *Shafts.* Partial penetrations of a cavity wall for the purpose of vertical distribution through one or more floor/ceiling assemblies may create a shaft condition which would require the enclosure of the duct within the wall cavity.

c. Electrical appurtenances, access panels, and miscellaneous recessed boxes.

(1) Partial penetrations of a wall exceeding 16 square inches in surface area for an electrical appurtenance which is not approved and/or not listed for use in fire-rated assemblies should maintain the fire-rating of the wall by one of the following:

- In a brick wall sufficient thickness of brick or concrete, as defined in Table 4-1 or Table 4-3 (see fig 4-4*a*).
- In a CMU wall sufficient equivalent thickness or CMU material, as defined in Table 4-2 (see fig 4-4*b*).
- Concrete of CMUs made of an aggregate providing higher fire resistance.
- The addition of fire resistant material of lesser but adequate thickness such as gypsum board, mineral wool batts, or fibrous material (see figs 4-4*c* and 4-4*d*).

If the penetrating electrical appurtenance is connected to conduit penetrating one or more floor/ceiling assemblies, then a shaft condition may be created which requires the conduit to be enclosed within the wall.

(2) Partial penetrations for metallic electrical boxes not exceeding 16 square inches in surface area require no firestopping except that in a hollow CMU wall partial penetrations should not occur in the same core on opposite faces of the wall.

d. Cable trays. Penetrations for cable trays should be provided with approved firestopping material installed in accordance with manufacturer's instructions (see fig 4-5).

4-4. Firestopping of gypsum board walls.

a. Pipes and conduits.

(1) Penetrations for pipes and rigid electrical conduit 4-inches or less in diameter and not subject to movement should be plaster patched tight to the pipe or conduit for the full thickness of a solid wall and as deep as possible but no less than the thickness of the boards on each face of a stud wall (see fig 4-6*a*).

(2) Larger pipes and pipes subject to movement should utilize sleeves, or be fully surrounded with mineral wool insulation (see fig 4-6*b*). Sleeves, when used, should be plaster patched as recommended for pipes in (1) above and mineral wool insulation should be provided between the pipe and sleeve for the full thickness of the wall (see fig 4-6*c*).

(3) Penetrations for pipes in load-bearing stud walls which are larger than 16 square inches in area should be boxed out with gypsum board, and mineral wool insulation should be provided between the pipe and framed prepared opening (see fig 4-6*d*). Where framed prepared openings in non-bearing walls are required under certain conditions, similar firestopping shall be used.

(4) Pipe penetrations may be firestopped with escutcheon plates if the assembly has been tested as proposed and is installed in accordance with criteria resulting from the tests.

b. Ducts.

(1) Through and partial penetrations for sheet metal ducts should be firestopped as specified for larger pipes or pipes subject to movement, with the addition of metallic flanges fastened to the duct and covering the penetration (see fig 4-7*a*). Sleeves should be plaster patched in place as recommended for pipes and mineral wool insulation should be provided between

the duct and sleeve for the full thickness of the wall (see fig 4-7*b*).

(2) Through and partial penetrations for sheet metal ducts in load-bearing stud walls should be boxed out with gypsum board (see fig 4-7*a*). The gap between the duct and board should be packed solid with mineral wool insulation, and metallic flanges fastened to the duct should cover the penetration.

(3) Ducts penetrating through walls required to be 2-hour rated or more should be provided with fire dampers or fire doors in accordance with TM 5-810-1 (see fig 4-7*a*).

(4) Partial penetrations. Duct penetration of one face of a stud wall for the purpose of vertical distribution within the stud space should be provided with:

— Additional layers of board directly behind the penetration to provide the required fire-rating of the wall (see fig 4-9).

— Enclosure of the duct with gypsum board within the stud space if the wall is load-bearing (see fig 4-9).

c. Electrical appurtenances.

(1) Individual penetrations of one face of a stud wall exceeding 16 square inches in surface area or multiple penetrations exceeding 200 square inches of surface area per 100 square feet of wall area for electrical appurtenances which are not approved and/or not listed for use in fire-rated assemblies should be provided with:

— Additional layers of gypsum board to maintain the required fire resistance rating (see fig 4-8*a*).

— Enclosure of the penetration by gypsum board within the stud space if the wall is load-bearing (see fig 4-8*b*).

If the penetrating electrical appurtenance is connected to conduit penetrating one or more floor/ceiling assemblies, then a shaft condition may be created which requires the conduit to be enclosed by gypsum board.

(2) Penetrations of a stud wall for metallic electrical boxes not exceeding 16 square inches in surface area should be plaster patched tight to the adjacent board if the gap between the box and board exceeds 1/8-inch. Such penetrations on opposite faces of walls should be separated by a minimum horizontal distance of 24 inches (see fig 4-8*c*).

d. Access panels and miscellaneous recessed boxes. Partial penetrations of a wall by an access panel or miscellaneous recessed box should be provided with:

— Additional layers of gypsum board to maintain the required fire resistance rating (see fig 4-8*a*).

— Enclosure of the penetration by gypsum board within the stud space if the wall is load-bearing (see fig 4-8*b*).

e. Cable trays. Penetrations for cable trays should be provided with approved firestopping material installed in accordance with manufacturer's instructions.

4-5. Firestopping of lath and plaster walls.

Firestopping of penetrations in hollow lath and plaster walls is identical to firestopping of gypsum board walls except that where additional layers of board are used in the latter, an additional built up thickness of plaster should be used in the former.

4-6. Firestopping of combination walls.

a. Through penetrations should be firestopped as required for the two outermost layers of the basic types comprising the combination wall, except that load-bearing stud walls which are part of combination walls should be firestopped to prevent internal heat build-up in the stud cavity by enclosure of the penetration in the cavity.

b. Partial penetrations should be firestopped as specified for the basic type of wall being penetrated.

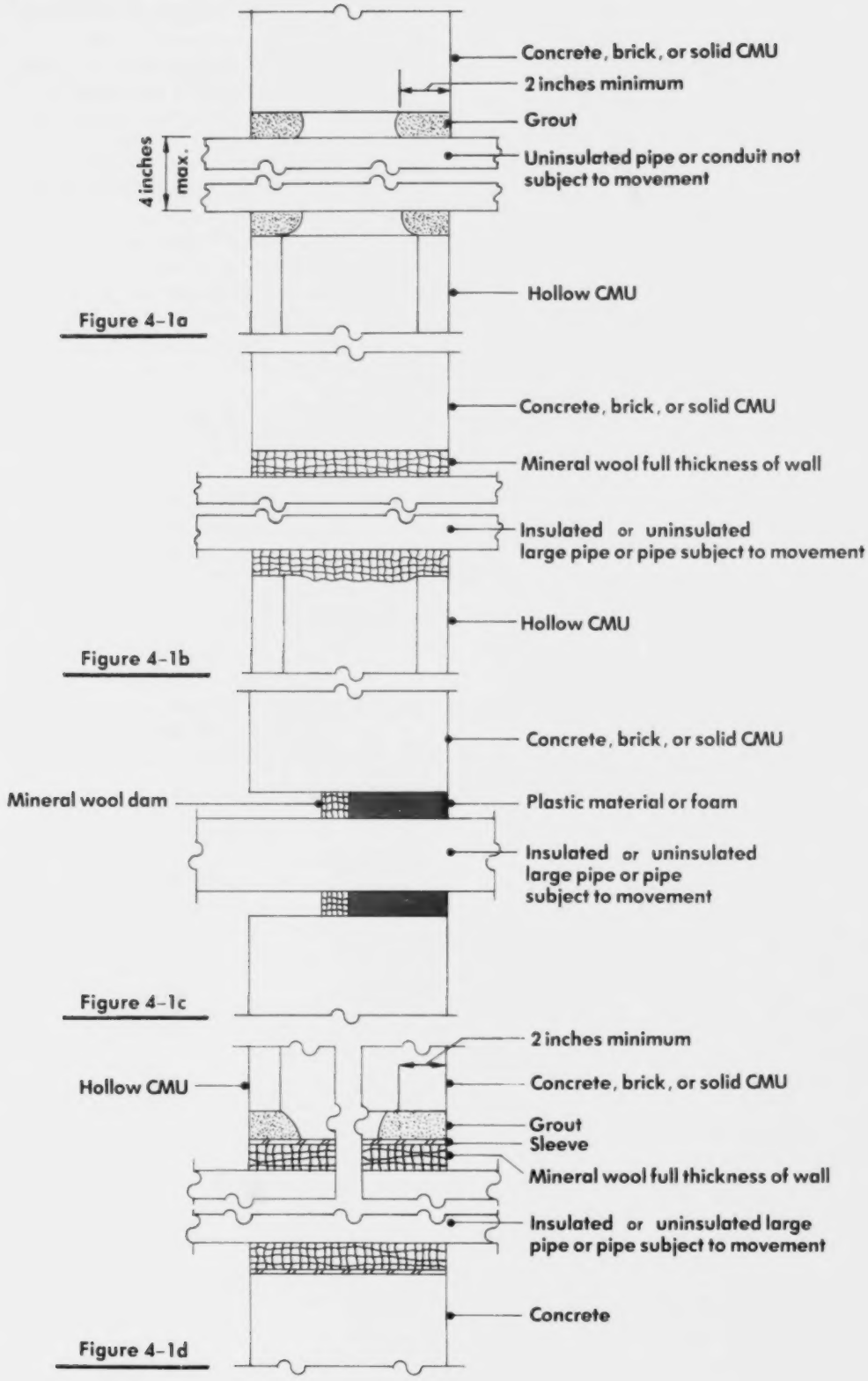

Concrete, brick, or solid CMU
2 inches minimum
Grout
4 inches max.
Uninsulated pipe or conduit not subject to movement
Hollow CMU
Figure 4-1a
Concrete, brick, or solid CMU
Mineral wool full thickness of wall
Insulated or uninsulated large pipe or pipe subject to movement
Hollow CMU
Figure 4-1b
Concrete, brick, or solid CMU
Mineral wool dam
Plastic material or foam
Insulated or uninsulated large pipe or pipe subject to movement
Figure 4-1c
2 inches minimum
Hollow CMU
Concrete, brick, or solid CMU
Grout
Sleeve
Mineral wool full thickness of wall
Insulated or uninsulated large pipe or pipe subject to movement
Concrete
Figure 4-1d

Figure 4-1. Through penetration of concrete and masonry walls by pipe or conduit.

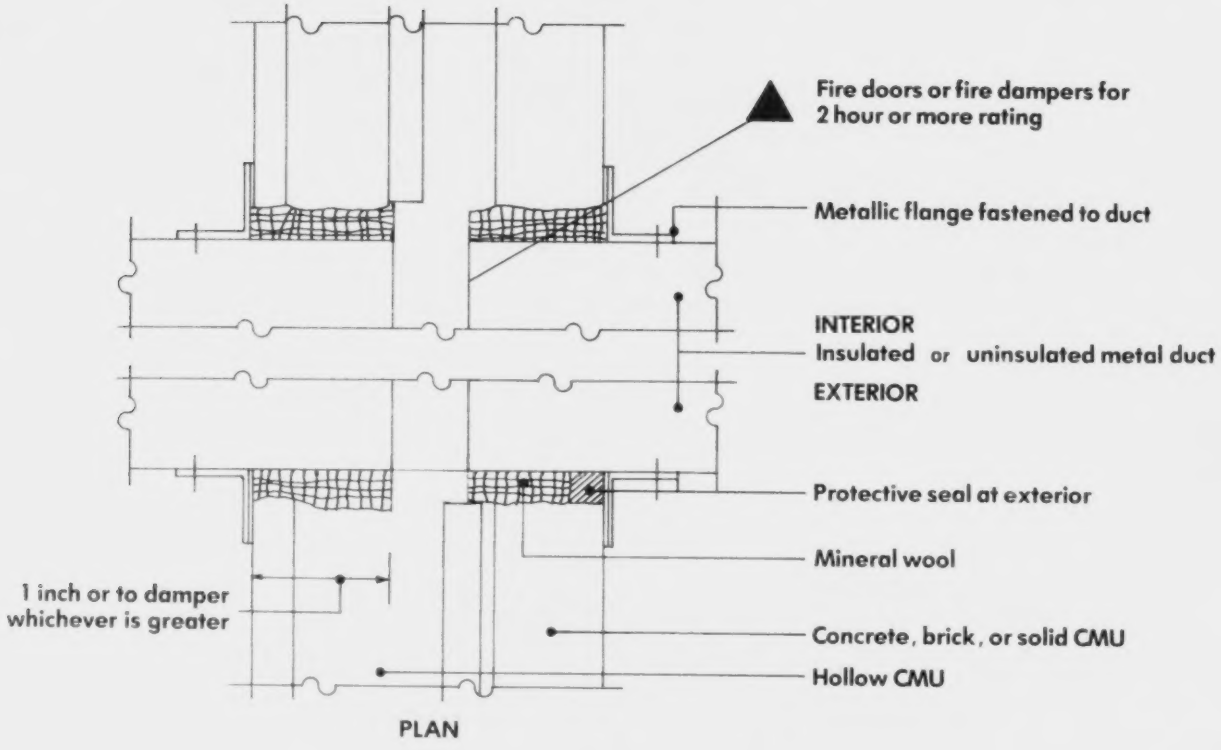
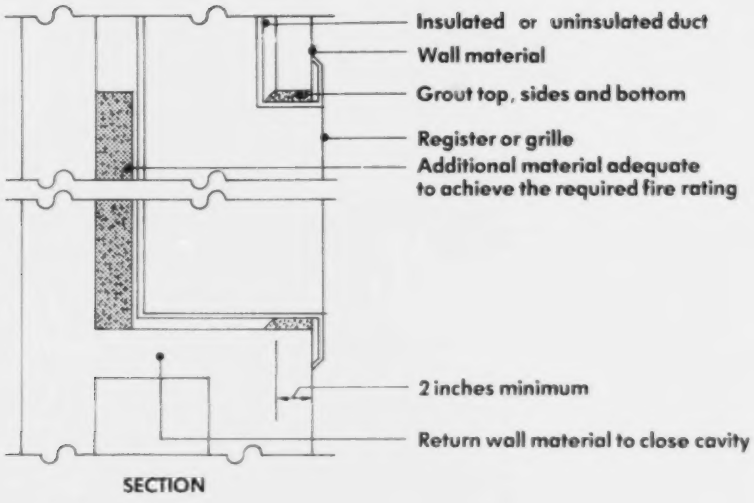

Fire doors or fire dampers for 2 hour or more rating
Metallic flange fastened to duct
INTERIOR
Insulated or uninsulated metal duct
EXTERIOR
Protective seal at exterior
Mineral wool
1 inch or to damper whichever is greater
Concrete, brick, or solid CMU
Hollow CMU
PLAN

Figure 4-2. Through penetration of concrete and masonry walls by metal duct.


Insulated or uninsulated duct
Wall material
Grout top, sides and bottom
Register or grille
Additional material adequate to achieve the required fire rating
2 inches minimum
Return wall material to close cavity
SECTION

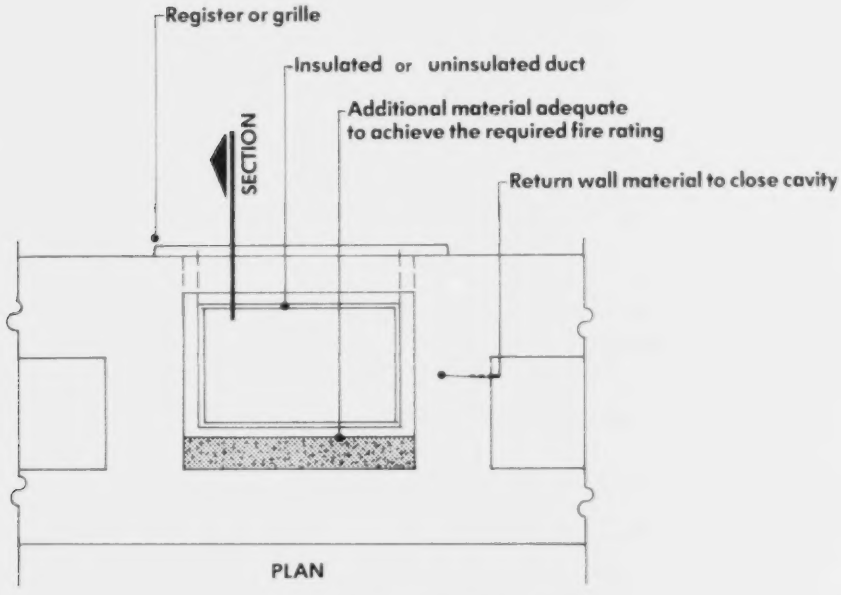

Register or grille
Insulated or uninsulated duct
Additional material adequate to achieve the required fire rating
SECTION
Return wall material to close cavity
PLAN

Figure 4-3a

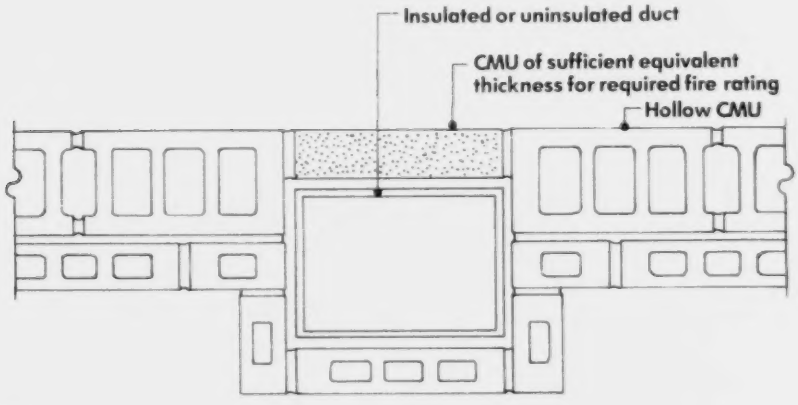


Figure 4-3b

Figure 4-3. Partial penetration of wall by metal duct.

Figure 4-4a

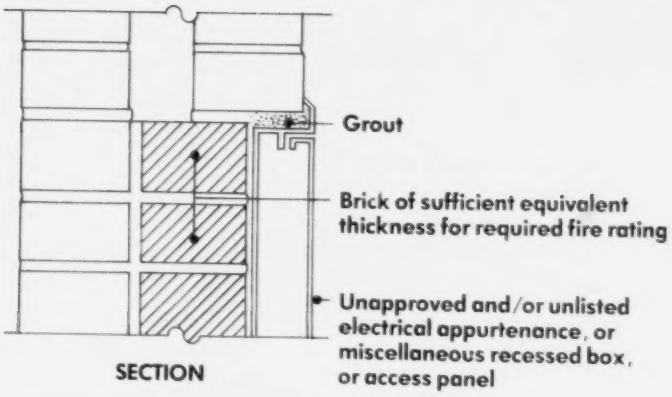

Grout
Brick of sufficient equivalent thickness for required fire rating
Unapproved and/or unlisted electrical appurtenance, or miscellaneous recessed box, or access panel
SECTION

Figure 4-4b

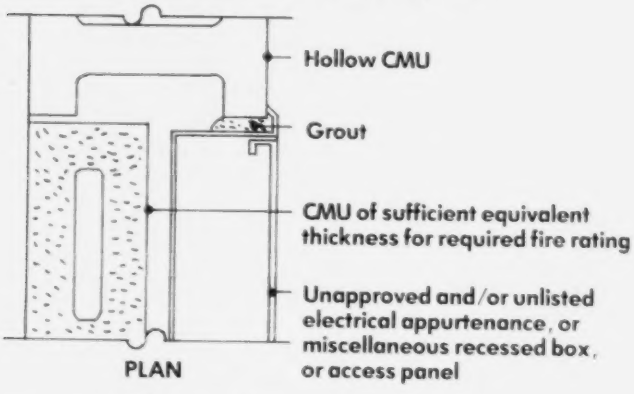

Hollow CMU
Grout
CMU of sufficient equivalent thickness for required fire rating
Unapproved and/or unlisted electrical appurtenance, or miscellaneous recessed box, or access panel
PLAN

Figure 4-4c

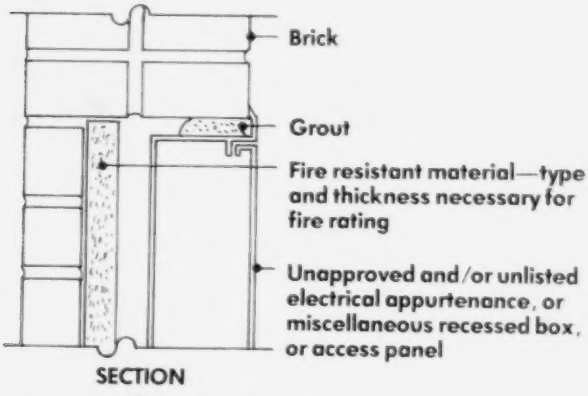

Brick
Grout
Fire resistant material—type and thickness necessary for fire rating
Unapproved and/or unlisted electrical appurtenance, or miscellaneous recessed box, or access panel
SECTION

Figure 4-4d

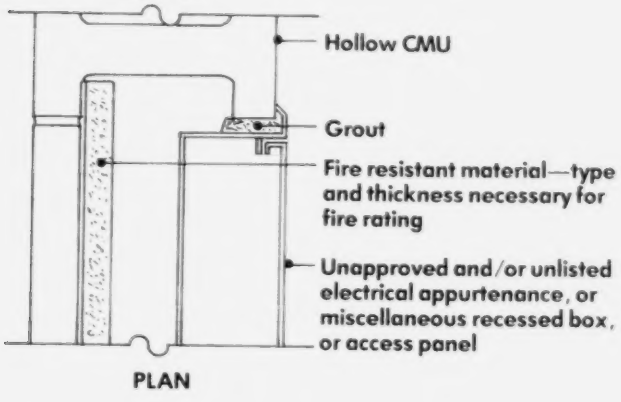
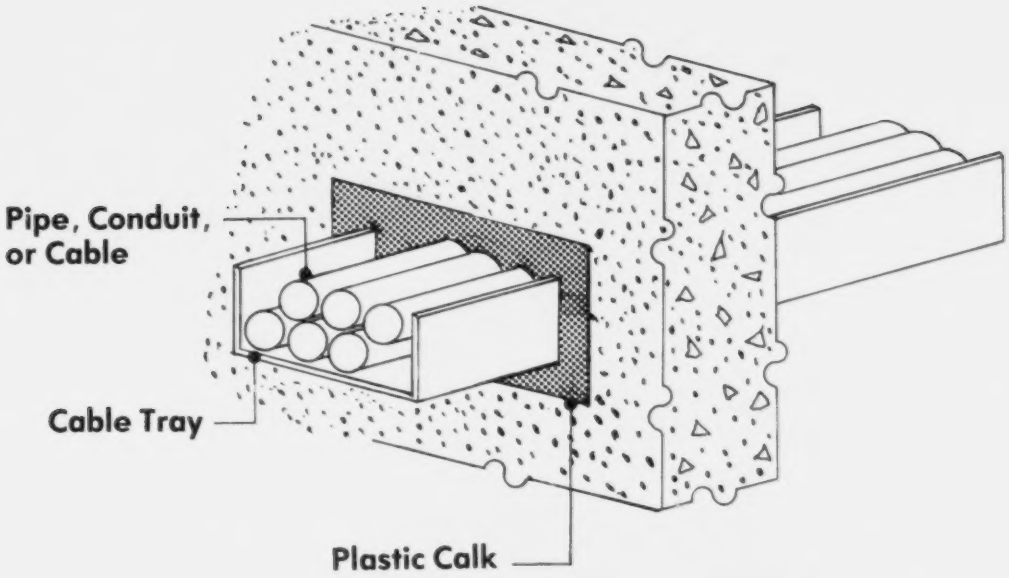

Hollow CMU
Grout
Fire resistant material—type and thickness necessary for fire rating
Unapproved and/or unlisted electrical appurtenance, or miscellaneous recessed box, or access panel
PLAN

Figure 4-4. Partial penetration of masonry walls by panels or boxes.



See U.L. Approved Through-Penetration Firestop System for Alternative methods

Figure 4-5. Through penetration for cable tray.

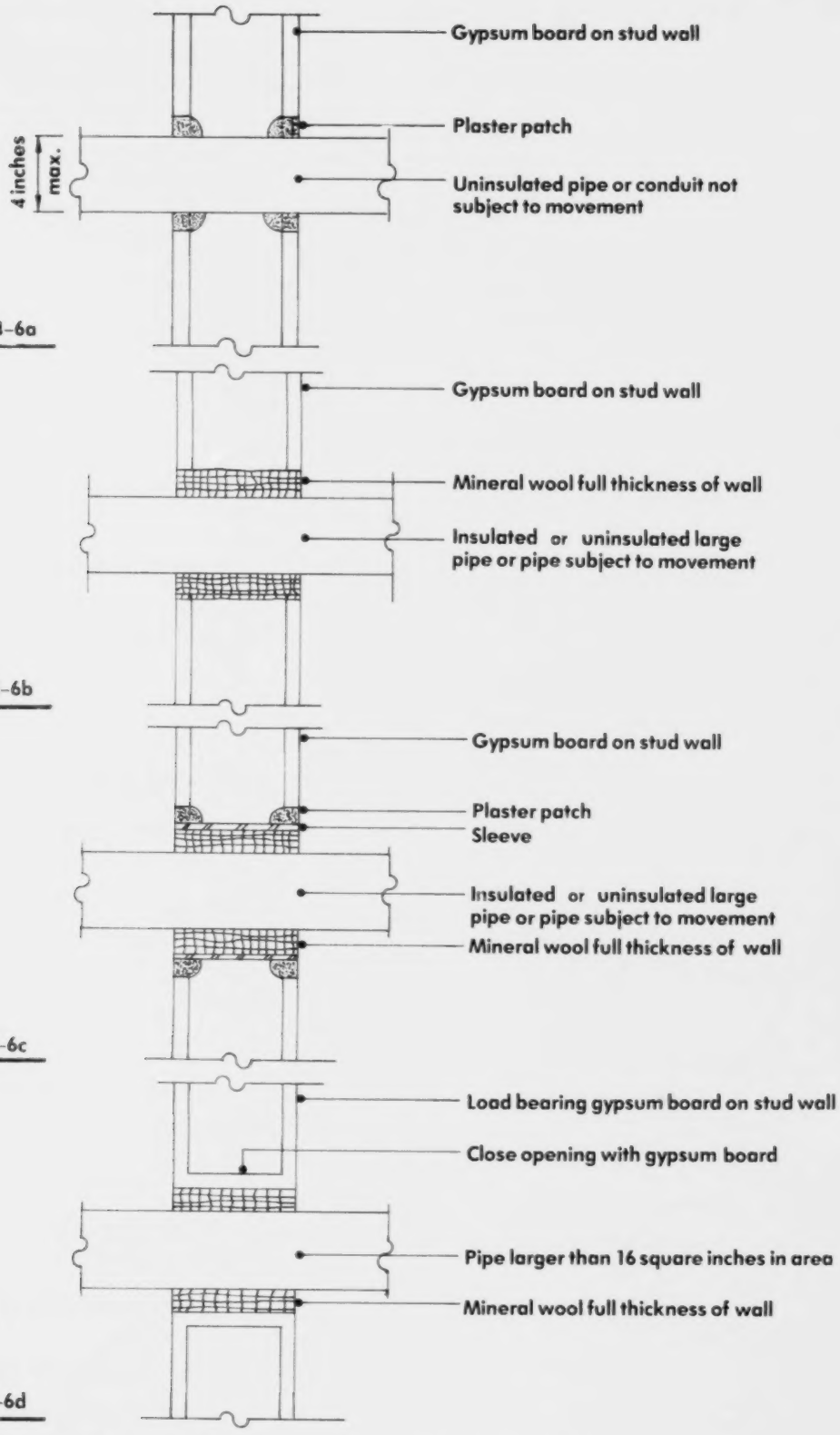

Gypsum board on stud wall
Plaster patch
4 inches max.
Uninsulated pipe or conduit not subject to movement
Figure 4-6a
Gypsum board on stud wall
Mineral wool full thickness of wall
Insulated or uninsulated large pipe or pipe subject to movement
Figure 4-6b
Gypsum board on stud wall
Plaster patch
Sleeve
Insulated or uninsulated large pipe or pipe subject to movement
Mineral wool full thickness of wall
Figure 4-6c
Load bearing gypsum board on stud wall
Close opening with gypsum board
Pipe larger than 16 square inches in area
Mineral wool full thickness of wall
Figure 4-6d

Figure 4-6. Through penetration of stud walls by pipe or conduit.

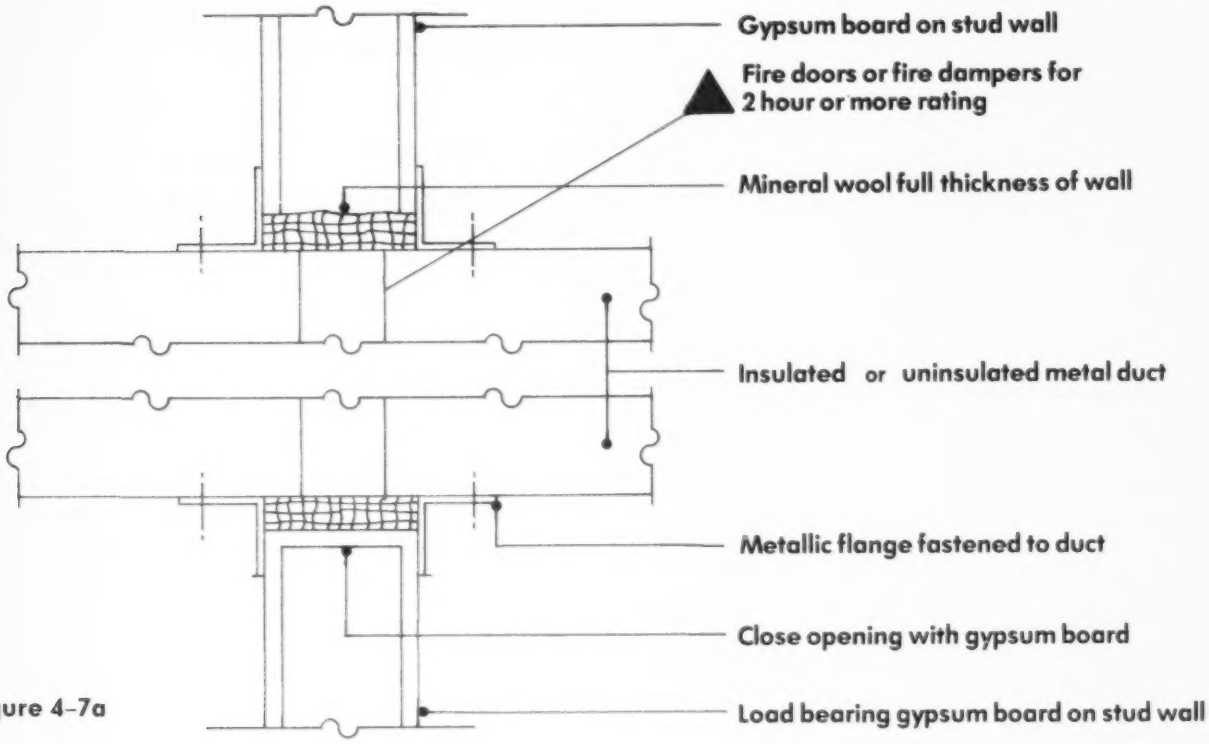

Gypsum board on stud wall
Fire doors or fire dampers for 2 hour or more rating
Mineral wool full thickness of wall
Insulated or uninsulated metal duct
Metallic flange fastened to duct
Close opening with gypsum board
Load bearing gypsum board on stud wall

Figure 4-7a

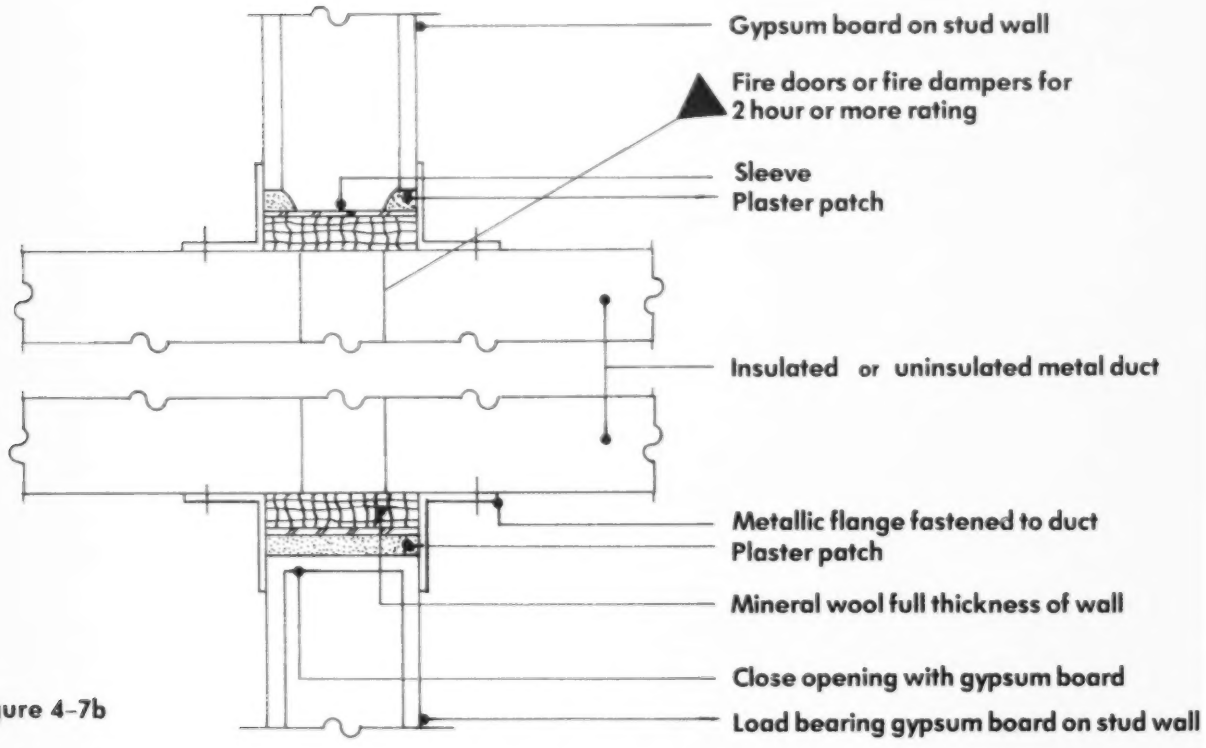

Gypsum board on stud wall
Fire doors or fire dampers for 2 hour or more rating
Sleeve
Plaster patch
Insulated or uninsulated metal duct
Metallic flange fastened to duct
Plaster patch
Mineral wool full thickness of wall
Close opening with gypsum board
Load bearing gypsum board on stud wall

Figure 4-7b

Figure 4-7. Through penetration of stud walls by metal duct.

Figure 4-8a

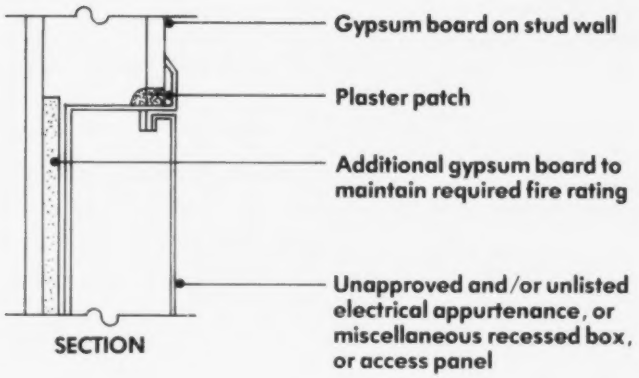

Gypsum board on stud wall
Plaster patch
Additional gypsum board to maintain required fire rating
Unapproved and/or unlisted electrical appurtenance, or miscellaneous recessed box, or access panel
SECTION

Figure 4-8b

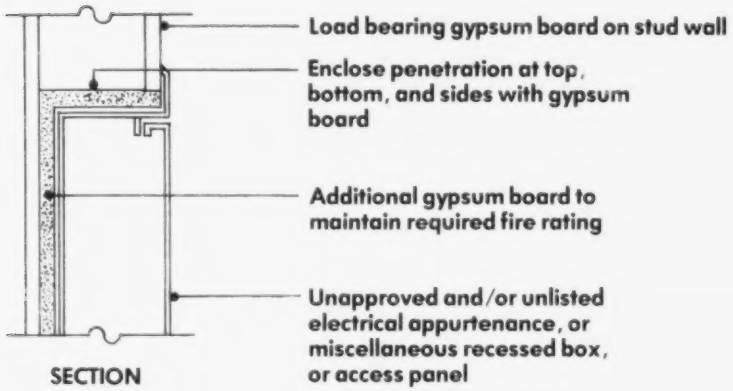

Load bearing gypsum board on stud wall
Enclose penetration at top, bottom, and sides with gypsum board
Additional gypsum board to maintain required fire rating
Unapproved and/or unlisted electrical appurtenance, or miscellaneous recessed box, or access panel
SECTION

Figure 4-8c

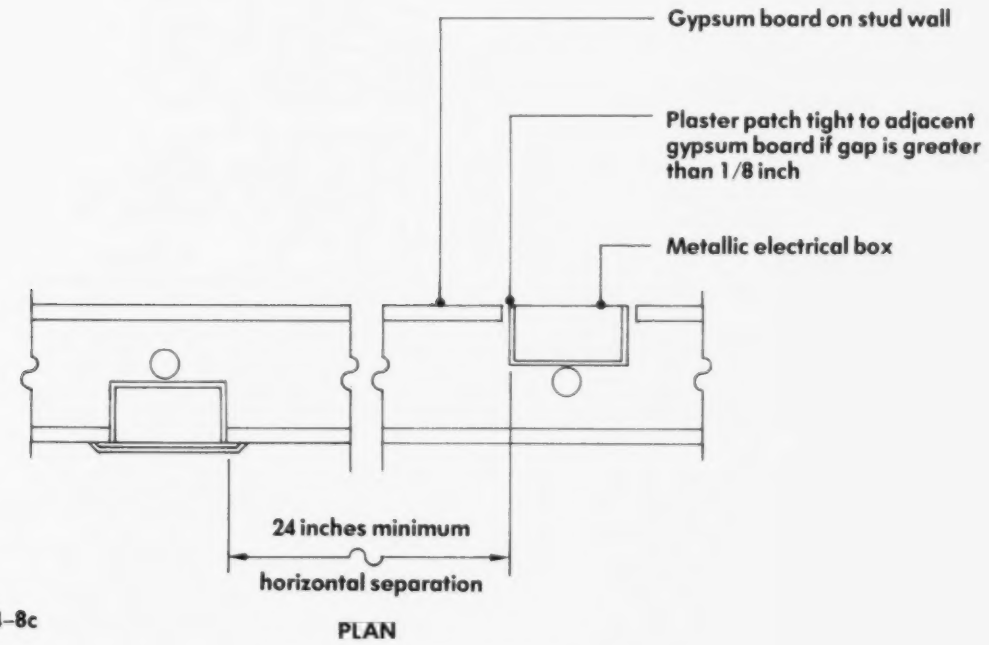
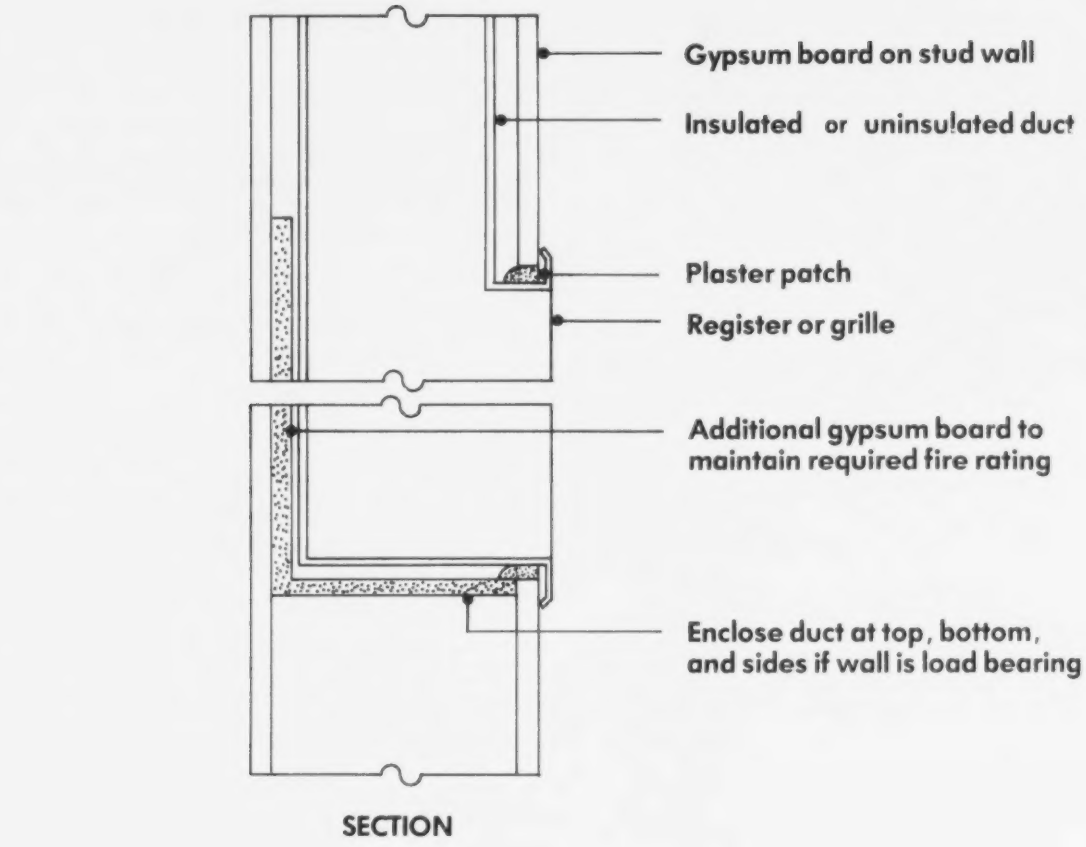

Gypsum board on stud wall
Plaster patch tight to adjacent gypsum board if gap is greater than 1/8 inch
Metallic electrical box
24 inches minimum
horizontal separation
PLAN

Figure 4-8. Partial penetration of stud walls by boxes or panels.


Gypsum board on stud wall
Insulated or uninsulated duct
Plaster patch
Register or grille
Additional gypsum board to maintain required fire rating
Enclose duct at top, bottom, and sides if wall is load bearing
SECTION

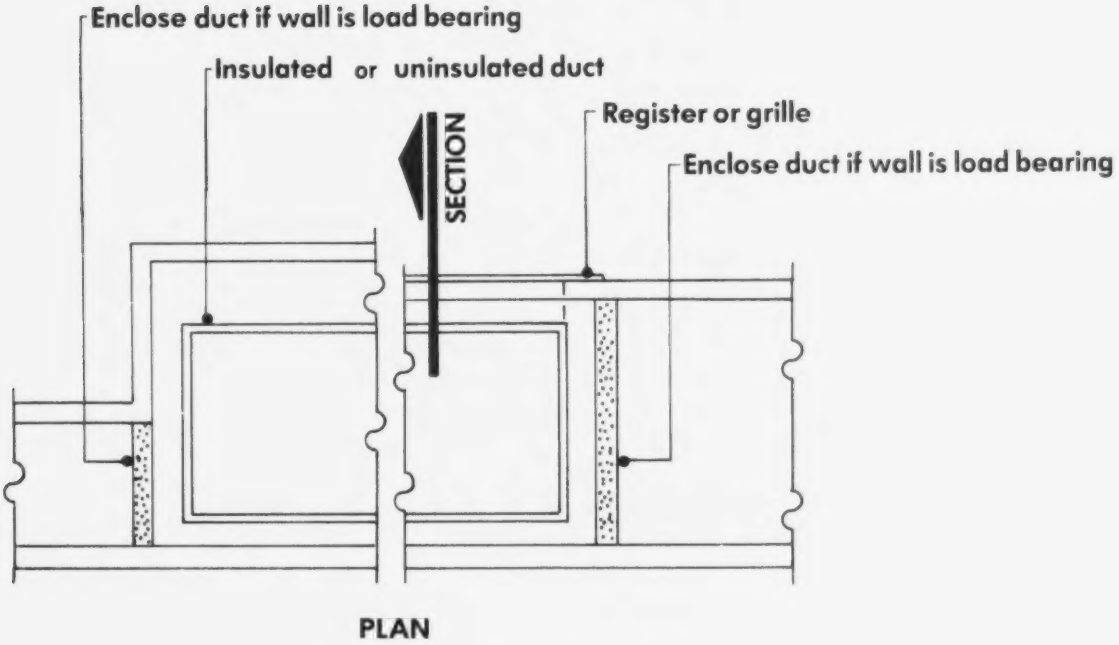


Figure 4-9. Partial penetration of stud wall by metal duct.

CHAPTER 5

FLOOR/CEILING ASSEMBLIES

5-1. Introduction.

a. This chapter prescribes the firestopping requirements for penetrations in the fire-rated floor/ceiling assemblies most commonly used in present day construction. These fire-rated assemblies are designed to preclude the vertical passage of heat and products of combustion between stories of a building and/or into the ceiling space. There are two types of fire-rated floor/ceiling assemblies:

— Cast-in-place and precast concrete floor systems which have established fire resistance ratings, tabulated as a function of the configurations of the assemblies.

— Composite floor and floor/ceiling assemblies which are assigned fire resistance ratings based on the results of ASTM E 119 tests performed for each assembly.

b. In many cases, penetration of rated floor/ceiling assemblies are of the partial type when only the ceiling element or the floor element is penetrated. Where full penetrations do exist, they are frequently contained within fire-rated shafts or concealed in finished wall or partition construction. This chapter covers penetrations other than those in a fire rated shaft enclosure.

c. Ducts penetrating rated floor/ceiling assemblies may be required to be enclosed in fire-rated shafts. Where shafts are not provided, approved fire dampers or fire doors are to be installed as required.

5-2. Concrete floor systems.

a. Fire resistance ratings.

(1) For purposes of fire resistance and firestopping, concrete floor systems are defined in this section as being those in which the required fire resistance rating of the floor/ceiling assembly is provided entirely by the structural floor element, and the fire-rating is tabulated for categories of assemblies. A suspended or attached ceiling element in a concrete floor system is not part of the fire-rated assembly. If a suspended or attached ceiling element is combined with a concrete floor system to form a fire-rated assembly, see paragraph 3 below.

(2) Concrete floor systems include cast-in-place structural slabs with either normal reinforcement or post-tensioning reinforcement, one-way and two-way pan joist-slab construction, filler block concrete construction, and precast, prestressed, or post-tensioned slabs or slab-tee combinations. Fire resistance ratings of concrete floor systems are based on:

— Minimum thickness of the slab.

— Type of aggregate.

— Minimum cover over reinforcing steel.

Nonstructural concrete fill placed over a structural concrete slab will provide additional fire resistivity, and the fire resistance rating of the combined system is essentially the same as that obtained if the slab were placed monolithically for its full thickness. Figure 5-1 lists fire resistance ratings for the various types of concrete floor systems.

(3) One-way and two-way pan joist-slab systems utilize metal forms to create either one-way or two-way joists cast monolithically with the structural slab. The fire resistance ratings of these types of systems are determined by the minimum thickness of the slab. Higher ratings can be achieved by adding a ceiling below the joists or by applying fire resistant materials directly to the bottom of the slab, thereby creating a composite floor/ceiling assembly.

(4) Filler block concrete floor systems utilize unit masonry, either in the form of concrete masonry units or clay tiles, laid in rows or in individual sections so as to create one- or two-way joists cast monolithically with the structural slab. The fire resistance ratings of filler block concrete floor systems are not predicated solely upon the thickness of the concrete slab but are enhanced by the added equivalent thickness of the unit masonry (see chap 4 for discussion of equivalent thickness of CMU).

b. Firestopping.

(1) *General.* Penetrations should not be made in either new or existing concrete floor systems unless approved by a structural engineer. The structural load carrying capacity of the system can be impaired by any penetration.

(2) *Pipes, conduits, ducts, and cables.*

(a) Through penetrations. Penetrations for pipes, conduits, ducts, and cables in concrete floor systems should be firestopped by mineral wool, plastic, or foam materials (see figs 5-2 and 5-3). Mineral wool should extend the full depth of the penetration, and may be covered with grout at the exposed face(s). Thickness and/or depth of plastic or foam materials

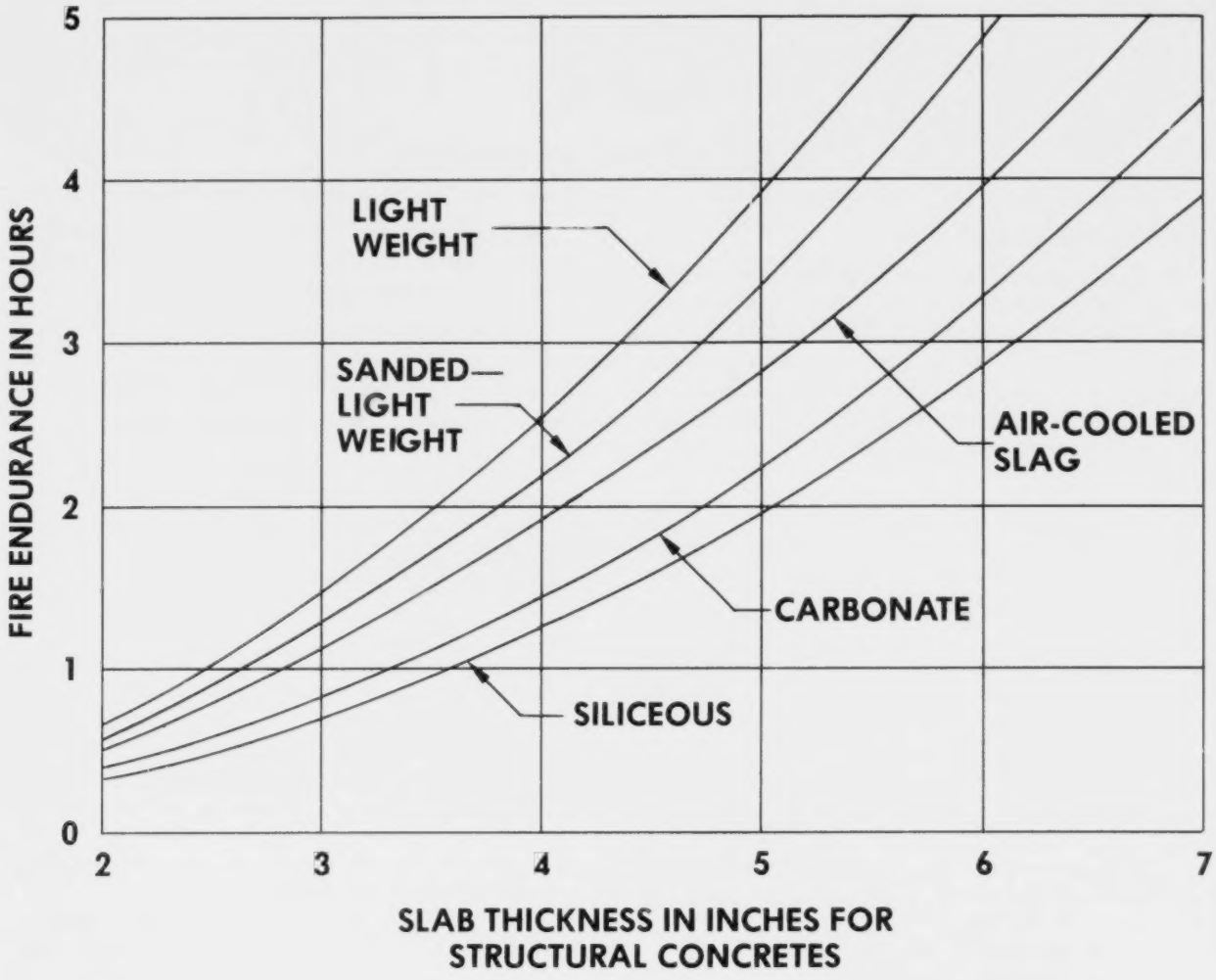


Figure 5-1. Fire endurance of concrete slabs.

should be as recommended by the material manufacturer and certified on the basis of ASTM E 814 tests. Ducts penetrating concrete floor systems, if not contained within fire-rated shafts, should be provided with rated fire dampers at the penetration (see fig 5-3).

(b) Partial penetrations. Under-floor pipes, conduits, or ducts contained within the concrete floor system which reduce the effective thickness of the slab should maintain the fire-rating of the floor/ceiling assembly by one of the following:

- Increase in overall slab depth so as to provide the minimum slab thickness required to achieve the fire resistance rating.
- Modification of the concrete aggregate to achieve the required fire resistance rating based on the decreased thickness.
- The addition of fire resistant material such as gypsum board, mineral wool batts, or fibrous materials (see fig 5-4*a*).

(3) *Electrical appurtenances.* Partial penetration of the upper or lower surface of concrete floor systems by an electrical appurtenance such as a luminaire, floor outlet box and the like, which is not approved and/or listed for use in fire-rated assemblies should maintain the fire-rating of the floor/ceiling assembly as required for partial penetrations for under-floor pipes, conduits, or ducts (see figs 5-4*b* and 5-5).

5-3. Composite floor/ceiling assemblies.

a. General. Composite floor/ceiling assemblies consist of a floor supported by structural members including joists or closely spaced beams, and a ceiling which may be attached directly to the bottom of the struc-

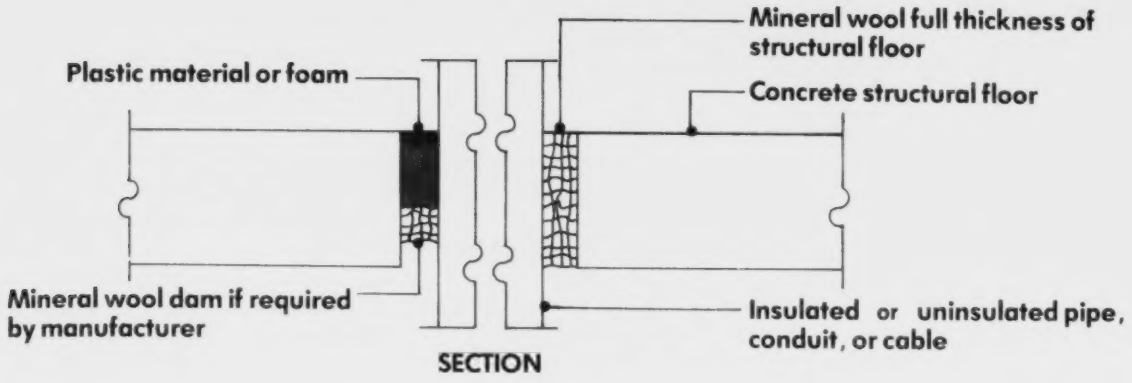

Mineral wool full thickness of structural floor
Plastic material or foam
Concrete structural floor
Mineral wool dam if required by manufacturer
Insulated or uninsulated pipe, conduit, or cable
SECTION

Figure 5-2. Through penetration of concrete floor by pipe, conduit, or cable.

tural members or suspended therefrom. The floor element of a composite assembly may be wood or structural concrete with or without steel deck. The structural elements of a composite assembly may be wood, steel bar joists, rolled steel sections, and cast-in-place or precast concrete. The ceiling element of a composite assembly may be gypsum board, plaster, rigid acoustic materials, and metal pans with or without acoustical material backing. Combustible floor/ceiling assemblies are those in which any of the elements of the assembly contain wood or other combustible material.

b. Fire resistance ratings. Composite floor/ceiling assemblies, with their diversity of materials and designs, require specific fire tests in accordance with ASTM E 119 to be performed for each system in order to obtain the fire resistance rating for that system. Accordingly, in order to assure that the fire resistance rating of the system used in the building is the same as that resulting from the test, the materials of construction used in the field must be identical to those tested (see para 1-4*d*).

c. Firestopping.

(1) *General.* The major firestopping concerns in a floor/ceiling assembly are penetrations of the ceiling and floor elements independently. Firestopping of ceiling penetrations is especially critical since this is the portion of the assembly directly exposed to the fire in the ASTM E 119 test. Under fire conditions, once the ceiling is violated, resultant temperature rises may have a detrimental effect on the load-carrying capacity of the structural supporting members in the assembly. Ignition temperature for wood varies between 395 degrees F and 600 degrees F depending on species, and steel starts losing its strength at approximately 1000 degrees F. During the ASTM E 119 test, furnace temperatures are 1000 degrees F after five minutes, 1700 degrees F at one hour, 1850 degrees F at two hours, and 1925 degrees F at three hours. This underscores the importance of the ceiling in preventing failure of the structural supporting elements.

(2) *Ceiling penetrations for pipes, conduits, and cables.*

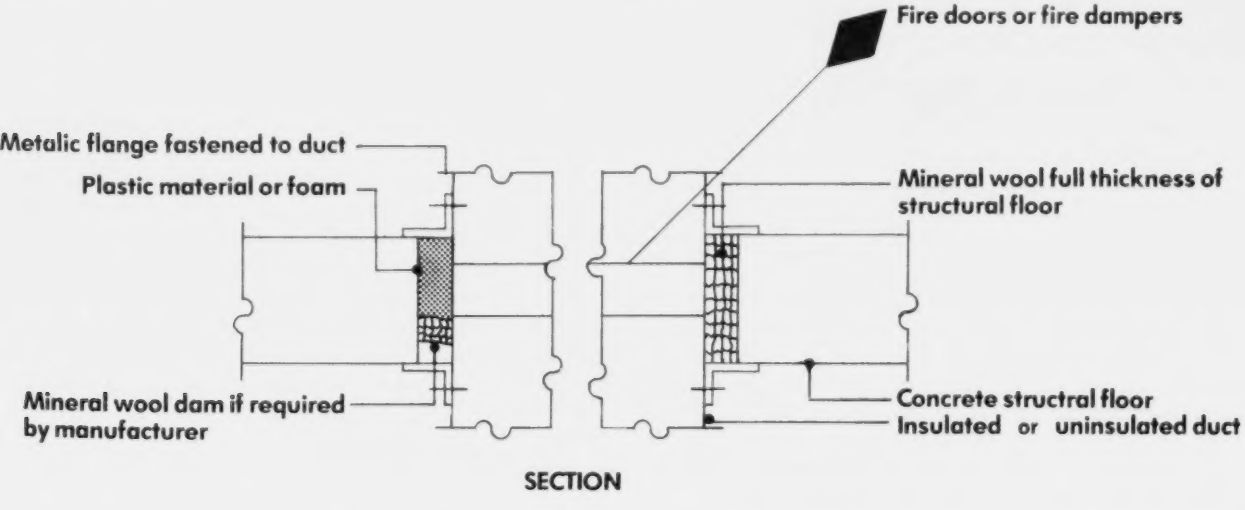

Fire doors or fire dampers
Metalic flange fastened to duct
Plastic material or foam
Mineral wool full thickness of structural floor
Mineral wool dam if required by manufacturer
Concrete structral floor
Insulated or uninsulated duct
SECTION

Figure 5-3. Through penetration of concrete floor by metal duct.

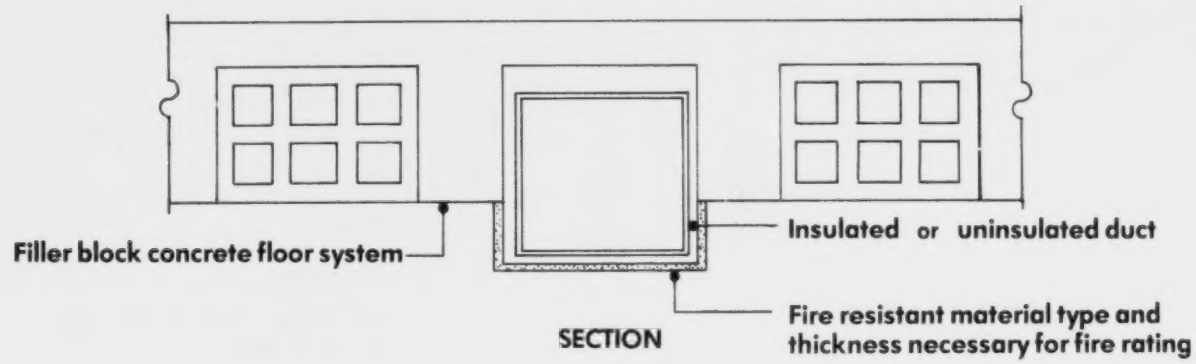

Filler block concrete floor system
Insulated or uninsulated duct
Fire resistant material type and thickness necessary for fire rating
SECTION

Figure 5-4a

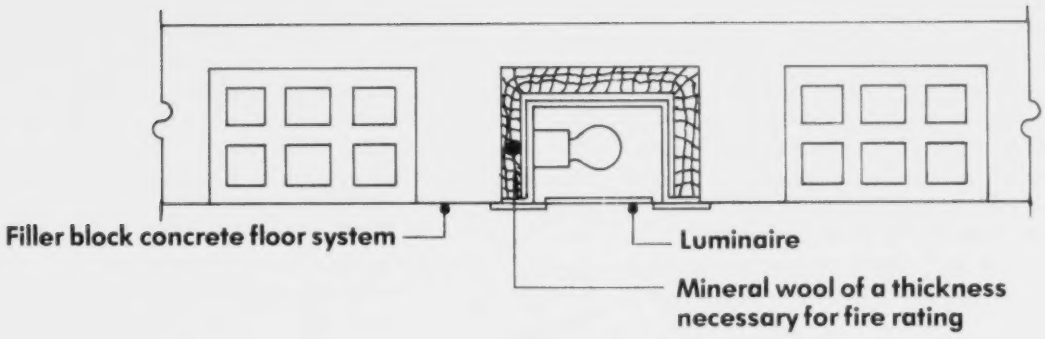


Figure 5-4b

Figure 5-4. Partial penetration of filler block concrete floor system.

(a) Gypsum and plaster. Penetrations for pipes, conduits, and cables should be plaster patched tight to the penetrating element as deep as possible, but no less than the thickness of the ceiling material (see fig 5-6).

(b) Acoustic materials. Penetrations for pipes, conduits, and cables should be fully surrounded with mineral wood insulation.

(3) *Ceiling penetrations for ducts.* Penetrations for ducts which are not enclosed in rated shafts should be firestopped as specified for pipes, conduits, and cables, and should be provided with ceiling dampers located at the penetration plane unless indicated otherwise as part of a listed tested assembly (see fig 5-7).

(4) *Ceiling penetrations for electrical appurtenances, miscellaneous boxes, and access panels.*

(a) Gypsum board and plaster. Penetrations of the ceiling by electrical appurtenances such as luminaires, boxes, and access panels which are not approved and/or not listed for use as part of the floor/ceiling assembly should be completely enclosed above and on the sides of the penetrating element by gypsum board or plaster, so as to maintain the continuity of the ceiling (see fig 5-8).

(b) Acoustic materials. Penetrations of the ceiling by electrical appurtenances, miscellaneous boxes, and access panels should be provided with additional acoustic material or fire resistive material above the penetrating element, in accordance with the details of the listed tested assembly.

(5) *Floor penetrations for pipes, conduits, cables, and ducts.*

(a) Concrete. Firestopping of penetrations of

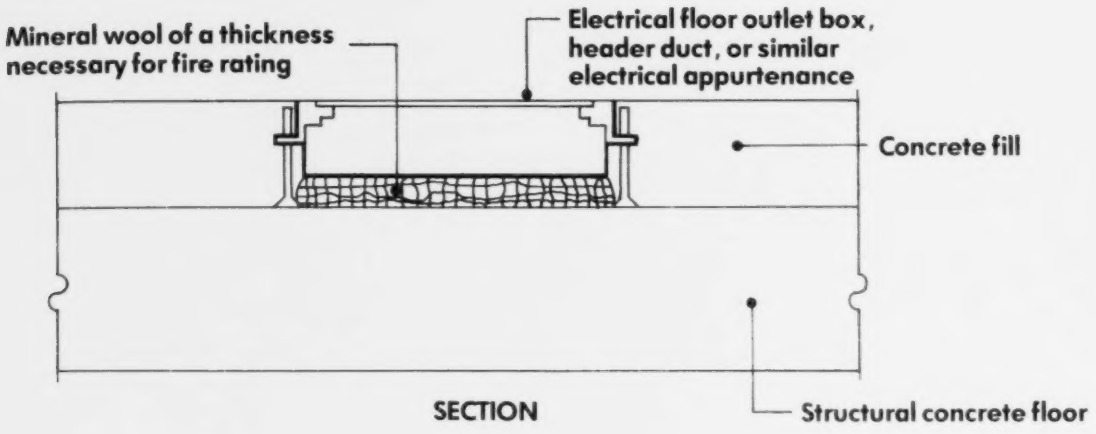

Mineral wool of a thickness necessary for fire rating
Electrical floor outlet box, header duct, or similar electrical appurtenance
Concrete fill
SECTION
Structural concrete floor

Figure 5-5. Partial penetration of upper surface of concrete floor system by electrical appurtenance.

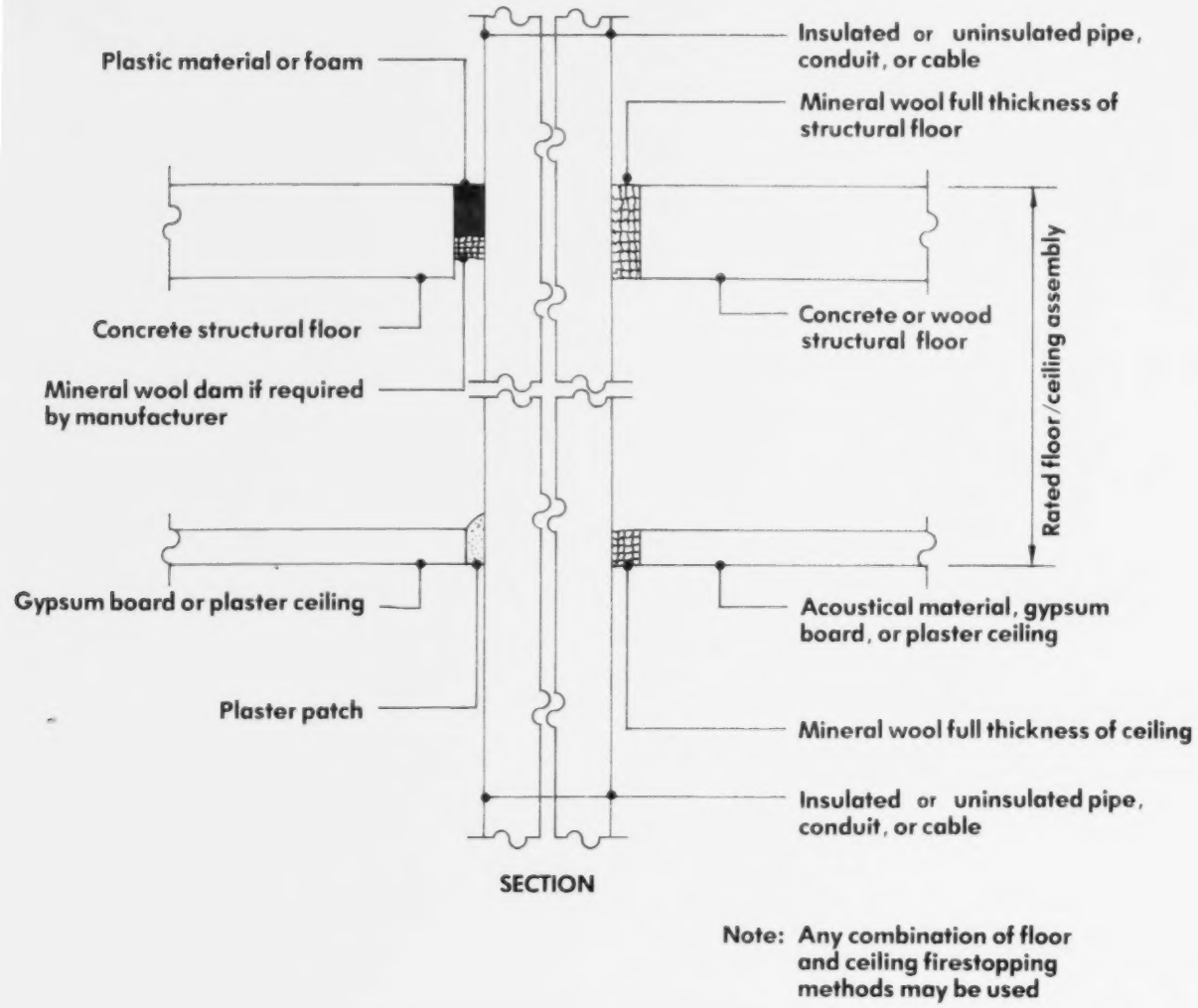

Plastic material or foam
Insulated or uninsulated pipe, conduit, or cable
Mineral wool full thickness of structural floor
Concrete structural floor
Concrete or wood structural floor
Rated floor/ceiling assembly
Mineral wool dam if required by manufacturer
Gypsum board or plaster ceiling
Acoustical material, gypsum board, or plaster ceiling
Plaster patch
Mineral wool full thickness of ceiling
Insulated or uninsulated pipe, conduit, or cable
SECTION
Note: Any combination of floor and ceiling firestopping methods may be used

Figure 5-6. Through penetration of floor/ceiling by pipe, conduit, or cable.

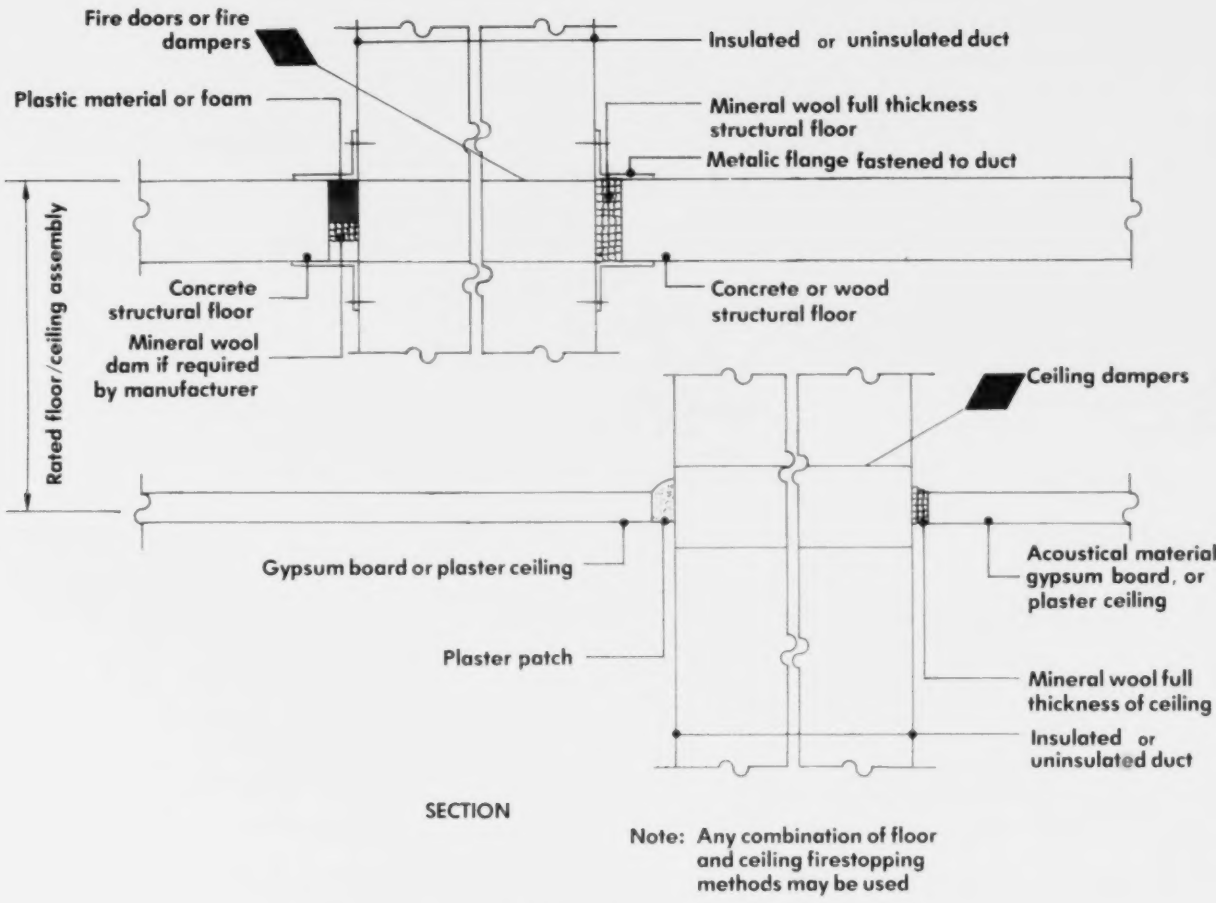

Fire doors or fire dampers
Insulated or uninsulated duct
Plastic material or foam
Mineral wool full thickness structural floor
Metalic flange fastened to duct
Rated floor/ceiling assembly
Concrete structural floor
Mineral wool dam if required by manufacturer
Concrete or wood structural floor
Ceiling dampers
Gypsum board or plaster ceiling
Acoustical material gypsum board, or plaster ceiling
Plaster patch
Mineral wool full thickness of ceiling
Insulated or uninsulated duct
SECTION
Note: Any combination of floor and ceiling firestopping methods may be used

Figure 5-7. Through penetration of floor/ceiling by metal duct.

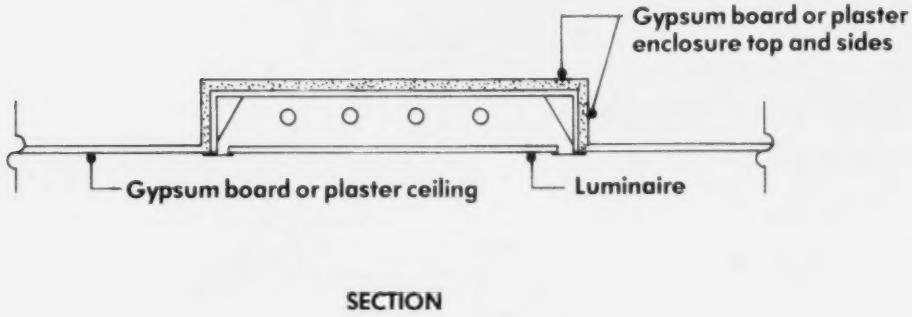


Figure 5-8. Partial penetration of rated ceiling by unapproved luminaire.

concrete floor elements which are part of a floor/ceiling assembly that includes a ceiling element should be done as specified for concrete floor systems (see figs 5-6 and 5-7).

(b) Wood. Penetrations for pipes, conduits, cables, and ducts may or may not utilize sleeves, depending on local job conditions. Penetrations should be of the minimum size necessary to accommodate the penetrating element, and should be firestopped with mineral wool insulation for the full thickness of the floor element (see figs 5-6 and 5-7). Firestopping with intumescent plastic materials or foam may be used if

tested.

(6) *Floor penetrations for under-floor pipes, conduits, ducts, and access panels.*

(a) Concrete. Such penetrations should maintain the fire resistance of the floor element as specified for partial penetrations of concrete floor systems, or in accordance with approved tests (see para 1-4*d* and fig 5-4*a*).

(b) Wood. Penetrations for access panels should be in accordance with approved tests (see para 1-4*d*)

5-4. Structural steel floor units with concrete floor fill and no suspended ceiling.

No penetrations (through or partial) should be made in such floor/ceiling assemblies except as tested and listed (see para 1-4*d*).

CHAPTER 6

ROOF/CEILING ASSEMBLIES

6-1. Introduction.

This chapter prescribes the firestopping requirements of penetrations in fire-rated roof and roof/ceiling assemblies. Unlike the floor and floor/ceiling assemblies discussed in chapter 5, which provide protection against the vertical passage of heat and products of combustion between stories of a building, the roof and roof/ceiling assemblies are designed only to maintain their structural integrity under fire conditions, and to maintain the integrity of the ceiling membrane and prevent the passage of smoke and flame into the ceiling space. Like floor/ceiling assemblies, there are two types of fire-rated roof/ceiling assemblies:

- Cast-in-place and precast concrete roof systems which have established fire resistance ratings which are a function of slab thickness, type of aggregate, and cover on reinforcing steel.
- Composite roof and roof/ceiling assemblies which are assigned fire resistance ratings based on the results of ASTM E 119 test performed to each specific assembly.

6-2. Special conditions.

Frequently under actual building fire conditions one of the first operations of responding fire service personnel is to vent the roof to prevent the build-up of heat, thereby reducing the possibility of failure of the structural roof system. This underscores the fact that firestopping of penetrations in roof/ceiling assemblies need address only those penetrations which may:

- Have an adverse effect on the structural integrity of the assembly.
- Cause combustible sheathing, insulation, and/or roofing to ignite when exposed to elevated temperatures.
- Be in close proximity to unprotected vertical openings into other parts of the same or an adjoining building.

6-3. Firestopping.

The methods of firestopping roof and roof/ceiling penetrations are the same as those described in chapter 5 for floor and floor/ceiling assemblies, except that in the case of a roof/ceiling assembly the firestopping penetration of the roof element of the assembly may be omitted where:

- Combustible roofing or combustible roof insulation is not present.
- The penetration of the roof element is located more than 15 feet from an unprotected vertical opening.

CHAPTER 7

COLUMNS, VERTICAL SHAFTS, AND OTHER SPECIAL CONDITIONS

7-1. Introduction.

This chapter addresses firestopping of penetrations of column protection, fire resistant rated shafts, and other special conditions.

7-2. Columns.

a. Fire-rated columns which may be penetrated are usually of the following types:

- Reinforced concrete including cast-in-place, precast, or prestressed with rating being a function of minimum cover provided for reinforcement.
- Structural steel shapes encased in concrete or unit masonry.
- Structural steel shapes with cementitious mixtures applied directly to column surfaces or applied to metal lath attached to the column.
- Structural steel shapes with intumescing mastics applied directly to column surfaces or applied to furring consisting of metal lath attached to the column.
- Structural steel shapes with gypsum or vermiculite plaster applied to gypsum lath or metal lath furring attached to the column.
- Structural steel shapes with gypsum board attached to metal framing.
- Structural steel shapes with high melt point mineral wool insulation.

In the latter type, the protection affording the fire resistivity is provided by proprietary materials and the specific ratings are achieved through ASTM E 119 tests. Other types of fire-rated columns, such as concrete-filled steel pipe, unprotected over-designed structural steel shapes, and heavy timber cannot be penetrated.

b. Column penetrations are generally of the partial type, i.e., an electrical receptacle or switch box, or piping that penetrates one face and extends vertically within the space created by column furring or is built into the fireproofing material applied directly to the column. Such penetrations should be firestopped as follows:

- In reinforced concrete columns the minimum reinforcement cover required by the resistance rating should be maintained (see fig 7-1*a*).
- In encased steel columns, the annular space around the penetration should be firestopped as required in chapter 4 for the respective encasing material (see fig 7-1*b*).
- In encased steel columns, material similar to that used for encasing the column should be added behind the penetrating element (see fig 7-1*b*).

7-3. Fire-rated vertical shafts.

a. Penetrations of fire-rated shaft enclosures should be treated in the same manner as previously described in chapter 4.

b. Vertical shafts penetrating through floor/ceiling assemblies should be continuously enclosed within the assembly plenum space. Since such shafts are required to be vented to the outside, penetrating elements contained within shafts, such as pipes and ducts, need not be firestopped within the shaft at floor/ceiling assemblies (see fig 7-2).

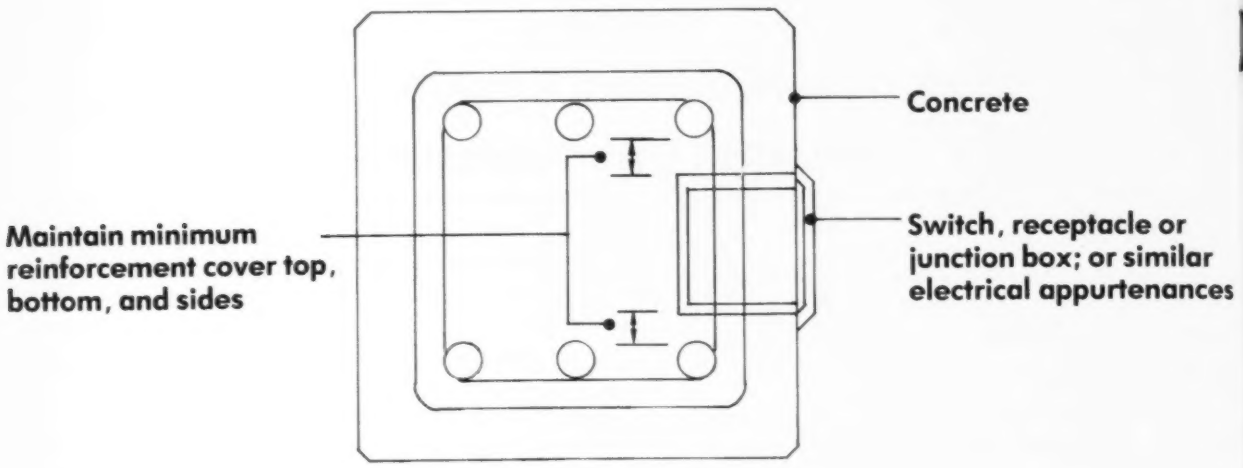

Concrete
Switch, receptacle or junction box; or similar electrical appurtenances
Maintain minimum reinforcement cover top, bottom, and sides
PLAN

Figure 7-1a

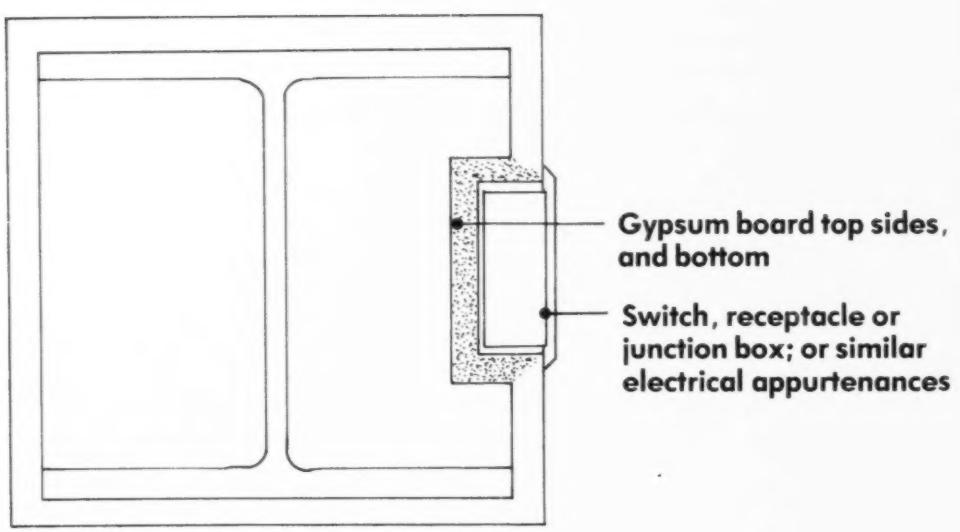


Figure 7-1b

Figure 7-1. Partial penetration of columns by electrical appurtenance.

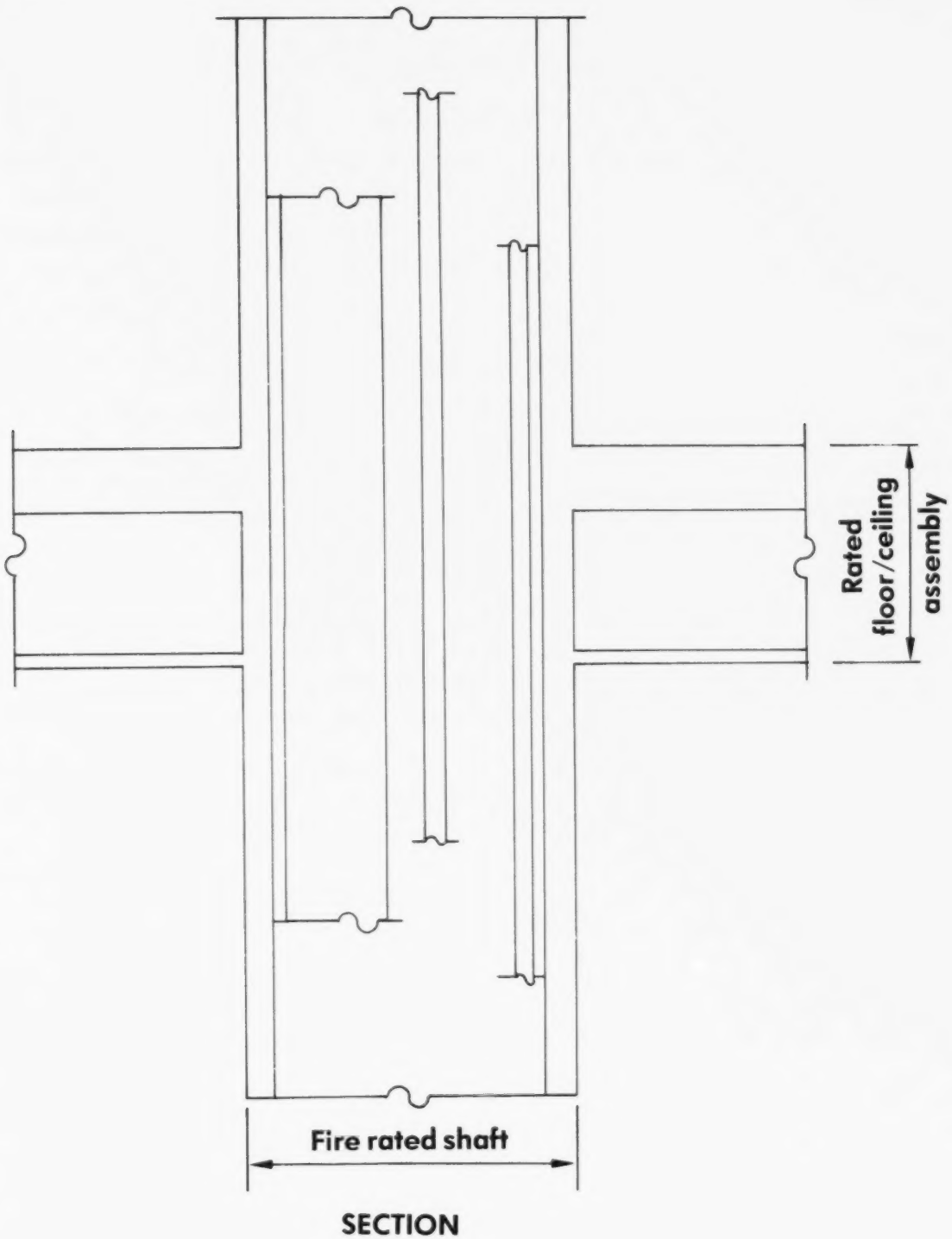


Figure 7-2. Vertical shaft penetrating floor/ceiling assembly.

APPENDIX A

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